VAYU

Aerospace & Defence Review

V/2021

THE INDIAN AIR FORCE AT 89

GROUND BASED AIR DEFENCE

Air superiority from the ground

In situations where every second counts, time is your most valuable asset. With time on your side, you can be prepared, in control, and gain the initiative. This is where Saab comes in. With our leading-edge sensor systems you can create time to act and protect your assets with solutions built on real-time control.

The G1X, member of the Giraffe family of 3D radars, provides high mobility, compactness, short deployment times, fast track initiation and high target update rates- all enabling command and control in the real time.

By creating time to act, you protect your assets with solutions built on actual real-time control - from the ground.

Learn more at saab.com

SAAB

Cover design by Angad J. Maolankar (Twitter: @noncommunistmao)

VAYU
Aerospace & Defence Review

V/2021

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

Published By

Vayu Aerospace Pvt. Ltd.
E-52, Sujan Singh Park,
New Delhi 110 003 India
Tel: +91 11 24617234
Fax: +91 11 24628615
e-mail: vayuaerospace@lycos.com
e-mail: vayu@vayuaerospace.in

Printed at Aegean Offset Printers

OPINION

Air Marshal Brijesh Jayal says...

"War memorials need to be treated with same respect as places of worship"

A recent report on Dehradun administration seeking names of World War 'martyrs', to be inscribed at the proposed Sainya Dham at Guniyal Gaon, is intriguing on two counts. The first, the proper term used for fallen heroes is either 'war dead' or 'killed in action'- and not 'martyr' as the latter more commonly signifies ' a person who is killed because of their religious or other beliefs'. Using this is disrespectful to the war dead.

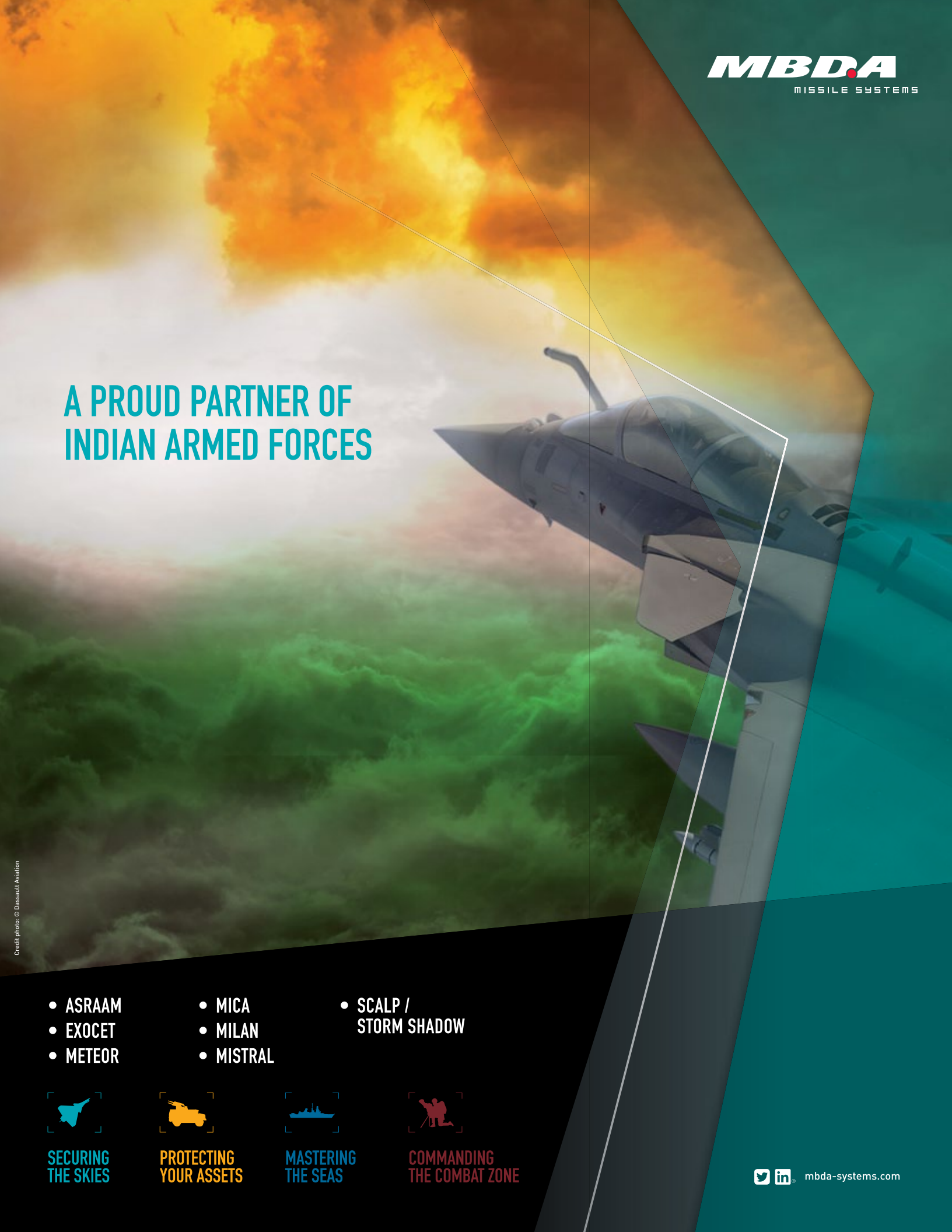
The proposed Sainya Dham at Guniyal Gaon appears to be a combination of a war memorial alongside other office and welfare facilities for the benefit of veterans. During the foundation laying ceremony, the then CM also hinted at it being a potential venue for oath taking ceremonies of future state governments. In the absence of any concept being available, it would appear that the proposed Sainya Dham will over time become a public place — for work, formal functions, play and recreation. Hence, any attempt to blend elements of a 'war memorial' within it are misplaced and would amount to sacrilege.

On visits to war memorials in India and abroad, one notices the serenity and dignity with which these places are treated by authorities and visitors alike. Personally, the experience has been more overpowering than a visit to a place of worship. Perhaps, it is the immortal spirit of those that are commemorated that makes these places inspiring and emotionally touching. At the Kohima memorial, when one reads a simple epitaph that reads, 'When you go home, tell them of us and say — For your tomorrow, we gave our today' — few can hold back emotions!

War memorials, however modest, need to be treated with the same degree of reverence and respect as are innumerable places of worship of all faiths. Many memorials lie neglected across this state and the one near Rajpur post office — dirty uncared for and surrounded by hawkers — is a classic example. A good start would be to document each such memorial and its history and make administrations accountable for upholding their upkeep and dignity.

It would be a sad day for the honour of our war dead, if the state authorities move ahead with an ill- conceived proposal of co-locating any sort of war memorial within the Sainya Dham. This would not be in keeping with the dignity with which a caring society honours its fallen soldiers — least of all, a land of 'Dev Bhoomi-Veer Bhoomi'. Let the authorities spell out their concept for Sainya Dham for public debate and proceed through consensus amongst not just veterans and their kin, but concerned citizens of the state as well.

(Photos for representational purposes only)



MBDA
MISSILE SYSTEMS

A PROUD PARTNER OF INDIAN ARMED FORCES

Credit photo: © Dassault Aviation

- ASRAAM
- EXOCET
- METEOR
- MICA
- MILAN
- MISTRAL
- SCALP / STORM SHADOW

SECURING THE SKIES

PROTECTING YOUR ASSETS

MASTERING THE SEAS

COMMANDING THE COMBAT ZONE

mbda-systems.com

Admiral Arun Prakash says...

Our Harmed Forces: 'Merit' principle is Dangerous. Officers at the very top are all able. Don't let politics enter that domain.

A news report in ToI's 9 August 2021 edition, headlined 'For top military posts, MoD weighs merit over seniority', may possibly have caused concern to many, and has compelled this veteran to pen his views on the topic.

In a bleak public administration scenario, the sole organisation that has not only functioned effectively but has risen to every occasion is the Indian military. Today, as he stands as a bulwark against Chinese soldiers in the Himalayas, the Indian soldier has remained the standard-bearer of constitutional values, discipline, patriotism, secularism and ethical conduct.

Integrity and ethical conduct are crucial. Success in war demands that soldiers have complete trust in each other. As we saw in Galwan last year, the Indian officer in junior ranks has invariably led from the front, taking very high casualties in battle, earning not just worldwide admiration, but the faith and confidence of his men.

However, as he climbs the slippery promotion-ladder to higher ranks, there are many ethical pitfalls that may trip up an idealistic young officer; most of them rooted in the very natural human trait of 'ambition'. Thus, it is vital for services to ensure that the system of promotions and advancement is as just, fair and transparent as possible, so that the rank and file remain confident that the leaders they unquestioningly follow deserve the position they have attained.

The military has a very fair methodology for selection of officers for promotion from the rank of Colonel to General (and equivalents in other services). The very fact that between 60-70% officers fall by the wayside, at each stage of promotion, speaks of the fierce competition and stringent selection criteria.

Promotion boards, convened periodically for placing officers on a 'select list' for promotion to ranks of Colonel and above, examine only annual confidential reports rendered periodically on candidates. ACRs contain numerical gradings for a number of attributes, as well as a 'pen picture' that describes the individual's qualities for the board and substantiates the grading. 'Merit', therefore, remains the sole criterion for the selection process by which a batch of 100 officers may be reduced to 10-12 by the time they reach 3-star rank.

An issue of unhappiness arises from the fact that the service chiefs are entitled to have the last say as far as ACRs of 2 and 3 star rank officers are concerned. This is quite appropriate, but like other reporting officers, chiefs, too, must provide full justification, via written remarks, for changing earlier gradings. Similarly, there may be many other areas of dissatisfaction and the need for reform certainly exists. This would also be a timely juncture to bring uniformity in personnel policies of the three services.

Therefore, on the 'merit versus seniority' debate for selection of new Commanders-in-Chief, there is need to tread with caution because any hasty step can inflict deep-rooted damage.

The current system of promotion to higher military ranks is based on the principle of seniority-cum-merit. As pointed out above, it consists of repeated winnowing of officers on the basis of merit alone. Therefore, the handful who 'run the gauntlet' and survive to reach top echelons are of uniformly high calibre. Choosing the senior-most, by date of promotion to his present rank (not by date of birth or date of commission), has, therefore, proved a 'safe bet' for decades.

On the other hand, by using some other definition of 'merit', the government could free itself from the constraint of 'seniority' but that would open the floodgates of unhealthy speculation. It is possible that by employing the 'deep selection' methodology and overlooking seniority, the MoD may unearth some outstanding officers.

But this must be weighed against two drawbacks: (a) the selectee would consider himself beholden to the politico-bureaucratic establishment, undermining his own credibility within the service; and (b) high-level military decisions may be skewed to please politicians.

Political polarisation, if allowed to take place in the military, would create deep fissures within the officer corps – eventually infecting the rank and file. Finally, it merits reiteration that the public respects the military for its apolitical and non-partisan conduct. But if the citizens perceive it as just another interest-group seeking to promote itself, that respect will soon vanish.

BORN TO BE BOLD AND WILD

HAPPY AIR FORCE DAY

www.rafale.co.in

OVER 60 YEARS. 6 AIRCRAFT TYPES. 1 NATION

TOOFANI | MYSTERE IV | ALIZE | JAGUAR | MIRAGE 2000 | RAFALE

V/2021

RAFALE INTERNATIONAL

DASSAULT AVIATION • SAFRAN 5 THALES

Admiral Arun Prakash also says....

"Why India's military leaders must have a free and frank discussion on demarcation of air power roles and missions"

Drawing by Amartya Mitra

India's Chief of Defence Staff (CDS) could have avoided controversy and the recent inter-service spat had he been a little more selective about phraseology. While the air chief was entitled to take umbrage at the IAF being termed a "support arm," no one could have reasonably objected if the CDS had described "air-power" as performing a support function, since the two are not synonymous.

One felt a sense of déjà vu at the ensuing uproar having witnessed similar scenarios during the proceedings of the 1999 Arun Singh Task Force as well as the 2011 Naresh Chandra committee on defence reforms. This was not the first time that air-power issues have triggered bitter debates that serve to stall and delay the process of defence reform in India — and elsewhere.

Ever since the advent of military aviation, air power has been the cause of fierce controversies and debates worldwide. While the outcome of strategic bombing in the Second World War remains an issue of disputation, the extensive employment of air power in support of land and maritime operations met with outstanding success. Allied air operations did, however, see multiple instances of inter-service overlap and confusion, and this led the US Congress to enact the National Security Act of 1947, which, apart from unifying the armed forces, created an independent US Air Force.

However, many issues related to resources as well as institutional boundaries remained unresolved and bitter infighting broke out between the US Navy and the USAF over aviation "roles and missions". Given the urgency of addressing these contentious issues, in March 1948, the US Secretary of Defence cloistered himself with the service chiefs, and, together,

they hammered out a consensus. This was enshrined in the "US Code of Federal Laws", and remains the legal basis for roles and missions of the US military.

In India, no such discussion has ever taken place and there is no mutually agreed upon or government-mandated demarcation of aviation roles and missions. Periodic "sniping" and even "poaching" has, therefore, taken place, leaving the IAF beset with a deep sense of insecurity, for reasons that I outline.

The 1970s saw an acrimonious debate between the IAF and the Indian Navy (IN) about the discharge of the maritime reconnaissance (MR) role, which the air force had inherited at independence. The penetration in 1971 of our waters by Pakistani submarines, having brought matters to a head, the government decided to hand over the MR role and aircraft to the IN in 1976.

The Indian Army, too, had been demanding the creation of an integral air arm, citing unsatisfactory aviation support by the IAF in forward areas. The issue became another inter-service squabble till the government intervened in 1986 and sanctioned the transfer of assets from the IAF to the newly formed Army Aviation Corps. The controversy did not end here as control of attack helicopters remained an issue of inter-service contention.

The IAF, having seen sister services appropriate its roles and assets, remained wary about jointness. Concepts of CDS and integrated commands which would require air assets being placed under non-IAF control, ring alarm bells in Air HQs. There are misperceptions on both sides of the "air-power divide", and the crying need of the day is for the tri-service leadership to sit around a table and provide mutual reassurance regarding service "roles and missions".

Air power, in the post-Cold War era, acquired a new aura. Based on the lethality and speed of modern air power, it is claimed that once "air dominance" has been achieved, the war is virtually won. In this paradigm, close support of surface forces receives low priority because quick military victories can be won from the air at minimal cost. However, such euphoric assumptions were based on recent conflicts where modern air forces wielding advanced technology had encountered irregular forces.

India, on the other hand, is faced with well-equipped, motivated and competent adversaries. The PAF, although numerically inferior, is a professional peer and has the assurance of Chinese support. The PLA Air Force not only outnumbers the IAF, but has the advantage of an advanced technological base. In our calculus, therefore, we cannot afford to bank on any specific advantage, nor speak nonchalantly about establishing "air dominance" over Pakistan or Tibet.

For too long have we treated the demarcation of air power roles and missions as a "holy cow" and shirked from free and frank discussion. The facade of inter-service bonhomie has concealed a germ of discord which needs to be exorcised. The conundrum that needs to be resolved is posed by the IAF's certainty about the "indivisibility of air power", versus the belief of the army and navy that aviation must be an integral resource, available at their disposal.

Questions that military leaders will need to address, jointly, are: One, should attainment of air dominance be an end in itself, superseding military and maritime strategies? Two, should air power be seen as merely an instrumentality to gain operational objectives on land, sea and air? Three, is there a via-media which will maximise the synergy and combat effectiveness of all three services, perhaps by modifying the IAF's 2012 doctrine?

Three final points need to be made in the closely related context of the joint commands being currently contemplated/constituted. First, it must be ensured that allocation of air power is not made piece-meal, but flows from an integrated, tri-service plan. Second, operational deployment of the command's aviation resources must be managed on behalf of the C-in-C, by his 2/3-star IAF component commander. Finally, the government must clarify that most high-level posts will, eventually, be tenable by officers of all three services. The rationale for integrated commands must, therefore, not be dictated by provision, to each service, of its "quota" of ranks/posts.

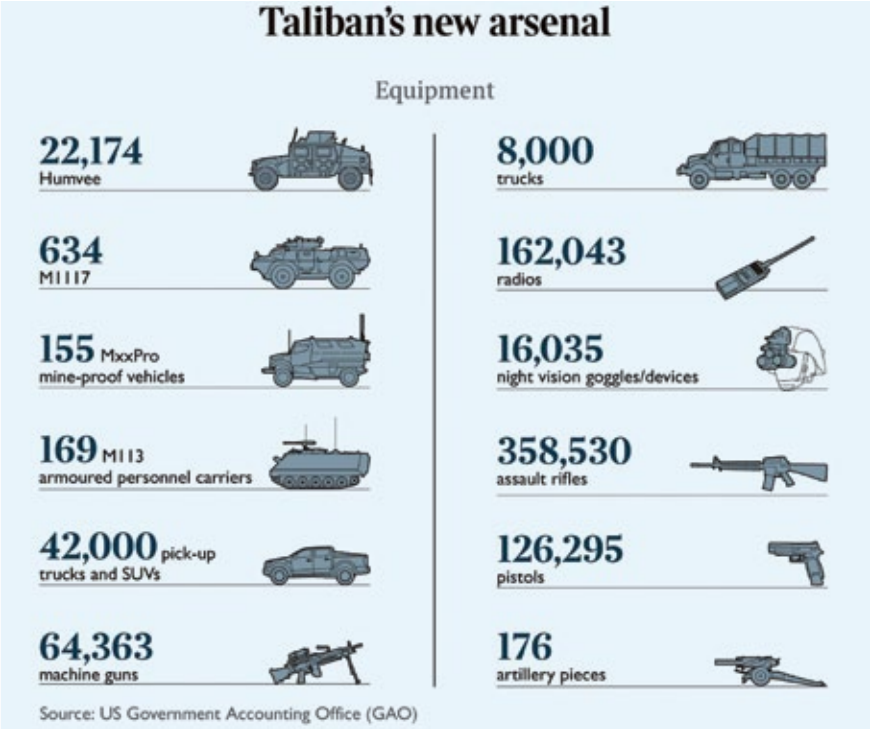
Geo Politics

Lt Gen Kamal Davar (Retd) cautions on

Re-Emergence of Global Terror

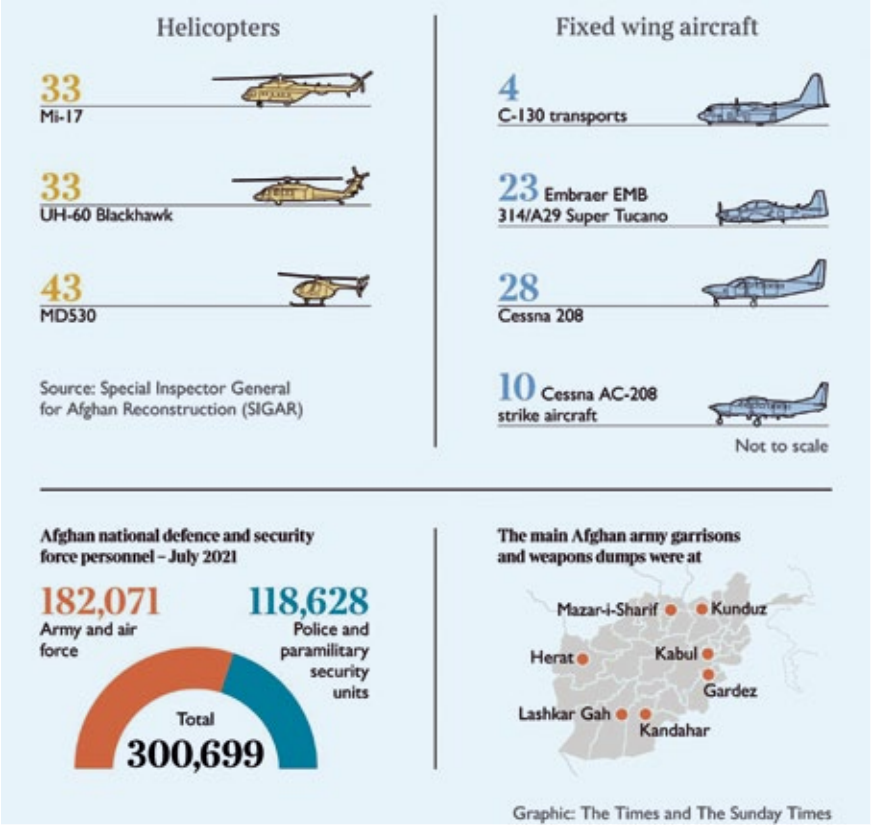
That Terrorism is the scourge of the world is a harsh truism of the times is beyond dispute since the last few decades. That global challenges necessitate global solutions requires no elaboration is also a universally accepted imperative—yet only in lip service and hardly ever adopted in practice. Why else would then the world, with inexplicable insensitivity and inaction, accept the most tragic happenings and the grave humanitarian crisis in intensely fratricidal violence driven Afghanistan? Failing to heed to the lessons of history, US President Joe Biden has committed a monumental strategic blunder in the undue hasty and unplanned exit of American troops from Afghanistan is now more than apparent beckoning dismay and condemnation from even US allies and sympathizers across the world especially by the hapless Afghans. Biden's folly anyway can never compensate the unimaginable human tragedy which has unfolded in ill-fated Afghanistan. That the wily, overly ambitious China with its willing foot-soldiers, the Pakistan government led by an internationally renowned cricketer but an utterly strategically naïve Imran Khan appear unduly jubilant not realizing the expiry date of their so-called euphoria. Both him and his Chinese mentors have endorsed the Taliban takeover. However, Islamic terrorism never deviates from its established goals and altruism and tolerance are not a part of it.

As the unimaginable tragedy unfolds itself with much pain and poignancy, the world barring some lip-service utterances, has hardly come out with a road map to manage this catastrophe. Has anyone ever witnessed wailing mothers handing over their infants to American soldiers heading home or to those who are lucky to have crossed over to neighbouring nations? Scenes at Kabul airport are reminiscent of hell having broken lose on earth. Though the evil Taliban has unleashed its traditional medieval terror on women and commenced executing those Afghans who allegedly had opposed them in the last few years, yet the rare courage displayed by some Afghan citizens has been exemplary. Many women and youngsters have openly defied the Taliban, marching on the streets and voicing their demands for women to lead normal lives and restoration of their human rights. They are strongly clamouring for being allowed to attend educational institutions and work outside their homes.



With the inexplicable capitulation of the Afghan Security Forces, without firing a shot and like a pack of cards, despite their numerical strength and far better equipment than the Taliban, the latter are virtually in control of the entire nation barring the Panjshir region and reportedly the neighbouring Baglan provine. Panjshir had during the earlier Taliban rule (1996-2001) been under the sway of the legendary Abdul Shah Masood who led the anti-Taliban and anti-Pakistan front, the Northern Alliance, composed mostly of the Tajiks, Hazaras, Uzbeks and a few Pashtuns. Now his son, Abdul Masood has raised the flag of Afghan nationalism alongwith former Afghan Vice-President, Amrullah Saleh against the Taliban who appear to have encircled the Panjshir defences and are waiting to mount an a offensive. That the Taliban hordes have been reinforced by Pathan suit wearing Pakistani soldiers cannot be denied by anyone. It is a matter of time that the Taliban will be mounting a determined and strong offensive to capture the Panjshir-Baglan region.

With Taliban in full control of Afghanistan, the re-emergence of all pervading global terrorism is a natural corollary. The Taliban will be the grateful mentors now of the Daesh, Al Qaeda, the Haqqani network and importantly major Pakistani terror organizations like the LeT, Jaish, Lashkar-e-Jhangvi, Jamaat-ul-Arhar and even the Tehreek-e-Taliban Pakistan among other tanzeems . Pakistan based terror outfits are anyway represented strongly in the current strife inside Afghanistan taking their orders from the top Taliban hierarchy whilst supporting them with foot soldiers and their diverse expertise honed by Pakistan's sinister Inter Services Intelligence (ISI). That the ISI would have prepared contingency plans to relocate some of these hardcore terrorists for intensifying terror operations in India's Jammu and Kashmir region does not brook any elaboration. It is not only India but all western nations may witness an upsurge in



Sunni sponsored terrorist activities with its roots in Afghanistan and Pakistan. That the American government, despite their military leaders and intelligence agencies spelling out unequivocally Pakistan's role in fostering terror continues to compound one mistake after the other, insisting to bail out Pakistan financially remains beyond anyone's comprehension.

With the Taliban takeover of Afghanistan, the jury is out declaring the winners and losers of this traumatic event. By any standards, China, Pakistan, Afghan Taliban, Turkey, the various terror tanzeems of the region and to some extent Saudi Arabia could be classified as the winners. However, the losers are distinctly Afghanistan itself, US, India, Shia Iran and the entire West. However, most nations are still being reticent to recognize the Taliban officially, though some among them would surely have established links with Taliban behind the scenes. Perhaps awaiting the entire evacuation of Indians and those of Indian origin wishing to come back to India is over, our government has not come out openly to condemn the Taliban!

China, since a few years has been eyeing the vast mineral resources of Afghanistan comprising the mining of gold, copper, rare earths and accordingly has invested heavily in Afghanistan to excavate its mineral wealth. Accurately gauging the weakness of the Ashraf Ghani government, China assisted by Pakistan, had opened up secret channels of communication with the Taliban leadership since the last year or so. Only last month it hosted a Taliban delegation where Chinese Foreign Minister Wang Yi had effusively praised the Taliban. And now with the Taliban in power in Afghanistan, China will work determinedly to fructify its strategic goals in Afghanistan. Apart from exploiting its mineral wealth the Chinese are more than wary of any Islamic terrorists from Afghanistan coming to the assistance of their fellow Uighur Muslims in the adjoining restive province of China's Xinjiang region. China has, since the last few years, launched a massive, brutal de-Islamization programme in Xinjiang and thus is sensitive to any assistance to the East Turkmenistan independence struggle from fellow Islamists from Afghanistan. Thus it will likely humour the Taliban leadership with massive economic aid to prevent such a development. Pakistan, naturally, will assist China in all such endeavours. Importantly, China will now link up its ambitious Belt and Road Initiative programme to its gains in Afghanistan by extending the China Pakistan Economic Corridor to the plains of Afghanistan and onwards also to the Chabahar port apart from the Gwadar port —- a major strategic gain. India will have its hands full to now convince the Iranians to honour their commitments to India as regards Gwadar. India cannot brush aside the compulsions of geography and proximity—- a mistake we have made in recent years by stopping oil imports from Iran.

India, having failed to convince its strategic ally, the US, to delay its departure from Afghanistan has hardly any worthwhile options left now in its Afghan policy. In the land of 'the Great Games' India has to protect its strategic interests notwithstanding the current setback to it from the Taliban-China-Pakistan axis. India must frame its policy serving its own interests which is neither American influenced or conceived from a Pakistani prism point of view. Though inordinately late, India must still work to evolve a regional consensus for Afghanistan with like-minded nations like Russia, Iran, Central Asian Republics, European Union and the UN. The US is gradually getting irrelevant in the region and their policies of 'blow hot-blow cold' towards terrorist outfits will hardly help India. Amazingly, just today the US has sent its Director CIA to confabulate with the Taliban leadership in Kabul! Meanwhile India must utilize its tenure in the UNSC to rein in Pakistan, work towards financial sanctions against it for Pakistan is the real cause of all of Afghanistan's tribulations. Not surprisingly the women, youth and other sections of the Afghan people have condemned Pakistan for its continuing machinations in Afghanistan. It is a matter of time that the proud Pashtuns will turn back on the Pakistanis and settle matters. The Tahfuz Afghan movement and the simmering Durand Line differences between the Pashtuns and Pakistan cannot be wished away by the latter.

The coming months are crucial for the stability and economic survivability of Afghanistan and also for Taliban's survival as a government and to be internationally accepted. India will have to monitor the fresh geopolitical realities of the region with caution. Pakistan, in all likelihood, will step up its iniquitous efforts to up the ante in J&K for which India must have contingency plans ready to deliver a telling reply to Pakistan in case it indulges in any mischief. Challenging times in the immediate future await India which must continually strive to sustain the enormous respect it has earned from the Afghan people since decades.

(This article first appeared in the Indian Defence Review)

Tribute

An air warrior at heart if not rank

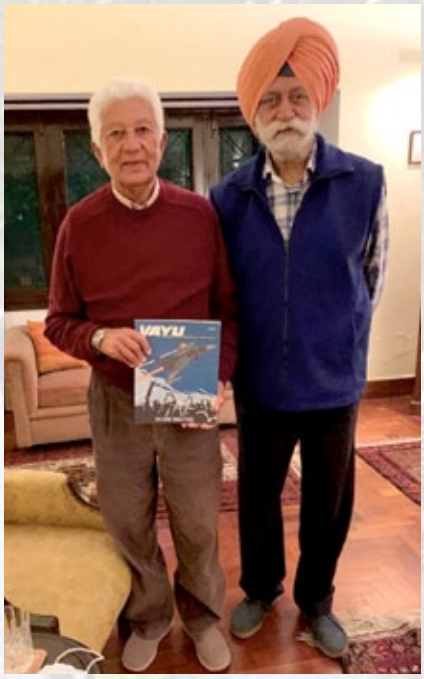
It felt strange to be opening the last edition of Vayu magazine with 'Remembering Pushpindar Singh' on its cover. Strange, because ever since he founded the magazine, it was an integral part of flight crew rooms across the IAF and every new issue subject to intense discussion and debate amongst the air force community. For someone like me who was also a personal friend, going through portions of the magazine almost felt like a conversation with him in a field that he was so passionate about, and one fast evolving in a technology intensive world. Though, over the years Vayu has nurtured many young minds who have taken the pressure off Pushpindar's shoulders and made his creation an international journal of repute; to me opening the pages of every issue was still akin to a conversation with Pushpindar. This chapter alas, is forever closed .

Also missing will be the 'go to' human encyclopedia to many ,on aeronautics in general and Indian aeronautics and the Indian Air Force in particular. Fortunately for the Indian aviation community, his passion and extensive writing in this field have nurtured a breed of aviation and history enthusiasts in his mould and the responsibility of carrying forward his legacy now rests on their shoulders.

His works have been documented and recognized nationally and internationally. Condolence messages from across the international community are testimony to his standing and reputation both as an authority on aviation matters and indeed as a historian.

Pushpindar was an air warrior in mind and spirit though not in formal rank. The best tribute that the nation and its aeronautics community can make to his everlasting contribution to furthering their cause and its history is to fill this void. Let the nation confer on him posthumously, an Honorary IAF Rank.

Air Marshal (retd) Brijesh Jayal



Air Marshal (retd) Brijesh Jayal with Pushpindar Singh at Dehra Dun in March 2021

Pushpindar Singh with the Ajeet he had organised to be installed at The Doon School, Dehra Dun

RFP for six P-75(I) submarines for Indian Navy

As a major initiative towards 'Make in India', Ministry of Defence (MoD) has issued Request of Proposal (RFP) for the first acquisition programme under the Strategic Partnership Model for construction of six AIP fitted Conventional Submarines named Project 75 P-75(I) for the Indian Navy on 20 July 2021.

Project-75(I) envisages indigenous construction of six modern conventional submarines (including associated shore support, Engineering Support Package, training and spares package) with contemporary equipment, weapons and sensors including Fuel-Cell based AIP (Air Independent Propulsion Plant), advanced torpedoes, modern missiles and state of the art countermeasure systems. The shortlisted SPs to whom the RFP has been issued would be collaborating with any of the shortlisted Foreign OEMs viz, Naval Group-France, TKMS-Germany, JSC ROE-Russia, Daewoo Shipbuilding and Marine Engineering Co Ltd-South Korea and Navantia-Spain.

Boosting indigenous capabilities in defence production

Defence Minister Mr. Rajnath Singh

The Government has taken several policy initiatives and brought in reforms to promote indigenisation and self-reliance in defence manufacturing, under AatmaNirbhar Bharat Mission in the defence sector. Ministry of Defence has notified a 'First Positive Indigenisation list' of 101 items on 21 August 2020 and '2nd Positive Indigenisation list' of 108 items on 31 May 2021 for which there would be an embargo on the import beyond the timelines indicated against them. These lists includes some high technology weapon systems like artillery guns, assault rifles, corvettes, sonar systems, transport aircraft, light combat helicopters (LCHs), radars, wheeled armoured platform, rockets, bombs, armoured command post vehicle, armoured dozor and many other items to fulfill the needs of the Defence Services. 1776 components and spares have been indigenised in the year 2020-21 as a result of efforts of indigenisation by DPSUs, OFB and.

MoD and defence corridors

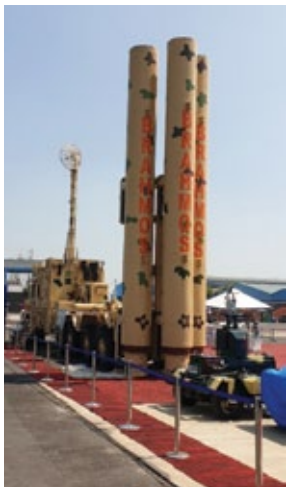
Government has established two Defence Industrial Corridors, one each in the States of Uttar Pradesh and Tamil Nadu. The investments of Rs 20,000 crore are planned in Defence corridors of Uttar Pradesh and Tamil Nadu by year 2024. The progress is reviewed regularly at apex level. So far, investment of approx. Rs 3342 crore have been made in both the corridors by public as well private sector companies. Moreover, the respective State Governments have also announced their aerospace & defence policies to attract private players as well as foreign companies including Original Equipment Manufacturers (OEMs) in these two corridors.

Two firms invest in UP's Defence Corridor

Two companies namely Delta Combat Systems Limited (Delta) and Werywin Defence Private Limited are investing Rs 215 crore in the Jhansi node of the Defence Corridor to set up their units for manufacturing smaller arms. The Delta Combat Systems Limited has been allotted 15 hectares of land to set up its plant at the cost of Rs 150 crore. It will make cartridges for assault, sniper and INSAS rifles as well as CQB carbines and other weapons being used by the armed forces.

BrahMos missiles may be manufactured in UP Defence Corridor

In a major development that could turn out to be a trendsetter uplifting the scenario of the state both economically and socially, UP may soon start manufacturing the next-gen state of the art BrahMos missile. The BrahMos Aerospace's CEO and MD Dr Sudhir Kumar Misra in a letter sent to UPEIDA CEO and Additional Chief Secretary (Home) Awanish Awasthi sought 200 acre land for the project at the Defence Corridor for making the BrahMos missile. The delegation from aerospace also met Chief Minister Yogi Adityanath.



Private players in defence manufacturing sector

The Defence Industry sector, which was hitherto reserved for the public sector, was opened up to 100% for Indian private sector participation in May 2001. As on date, 333 Private companies have been issued a total of 539 Industrial Licenses. Out of these, 110 companies have reported commencement of production. Out of the total Capital Acquisition Budget for the year 2021-22, 64.09% has been earmarked for domestic capital procurement. Defence capital outlay has been increased by 18.75 % in the budget of 2021 – 22.

Indian Army grants time scale Colonel Rank to women officers

A Selection Board of the Indian Army has cleared the way for the promotion of five women officers to Colonel (Time Scale) rank, post completion of 26 years of reckonable service. This is the first time that women officers serving with the Corps of Signals, Corps of Electronic and Mechanical Engineers (EME) and the Corps of Engineers have been approved to the rank of Colonel. Previously, promotion to the rank of Colonel was only applicable for women officers in the Army Medical Corps (AMC), Judge Advocate General (JAG) and the Army Education Corps (AEC). The widening of promotion avenues to more branches of the Indian Army is a sign of increasing career opportunities for women officers.

HAL signs contract worth Rs 5375 Crores with GE Aviation

HAL has placed an order of for USD 716 million (Rs 5375 crores) for 99 F404-GE-IN20 engines and support services with GE Aviation, USA to power the Tejas Light Combat Aircraft. "This is largest ever deal and the purchase order placed by HAL for LCA", stated Mr. R. Madhavan, CMD, HAL. The Company is working closely with GE for its support to pursue the export potential of

LCA and also to supply spares to the global supply chain of GE 404 engines, he added. Ordering of the engines, marks a major milestone in the execution of 83 LCA contract with IAF. The co-operation will be further enhanced with the manufacturing of GE F414 engines in India for the upcoming LCA MkII programme.

Vice President visits HAL facilities

The Vice President, Mr Venkaiah Naidu, paid his maiden visit to HAL facilities accompanied by Mr Thaawarchand Gehlot, Governor of Karnataka on 20 August. "I am assured of our nation's security and safety after seeing this impressive infrastructure in aerospace and defence," he stated in his address to senior officers of HAL and ADA. He hailed the ongoing public-private partnership in various defence projects of HAL and said all efforts should be made to develop cutting-edge technologies indigenously to strengthen India's defence against the background of the complex geo-politics. The dignitaries visited LCH, ALH Hangars, and LCA Tejas division.

On 25 August 2021, members of Standing Committee on Defence led by Mr. Jual Oram visited HAL facilities and witnessed a flying display at HAL airport, Bengaluru.

Privatisation of defence establishments

There is no proposal of privatisation of Defence Public Sector Undertakings (DPSUs) and Ordnance Factory Board (OFB) under the administrative control of Department of Defence Production. However, to enhance functional autonomy, efficiency and unleash new growth potential and innovation in Ordnance Factories, the Cabinet Committee on Security (CCS) in its meeting has approved to convert the production units of OFB into 7 DPSUs.

Cyber warfare

Government has approved establishment of Defence Cyber Agency, under the aegis of Ministry of Defence. This agency is now fully functional. To mitigate cyber threats, all the three Services have established their respective Cyber Emergency Response Teams (CERT). Furthermore, Government of India is formulating the National cyber security strategy, which is in the final stages of approval.

Goa Shipyard Limited has signed a contract with the Ukrainian state-owned enterprise Zorya-Mashproekt for supply of two sets of M7N Main Gas Turbine Aggregate for the new Talwar-class frigates being built at GSL for the Indian Navy.

DRDO and strengthening the defence manufacturing sector

DRDO has taken the following measures for strengthening the industry to reduce the timelines from development to induction:

- Accessibility of DRDO Test Facilities to Indian Industry.
- Identification of Development-cum-Production Partner/ Production Agency/ Lead System Integrator (DcPP/ PA/ LSI) for early integration of industry.
- Technology Development Fund (TDF) has been implemented to provide support for design and development of technologies/ prototypes, indigenisation of imported systems/ components and new systems especially by MSMEs/ Start-ups.
- Simpler Transfer of Technology (ToT) Policy to encourage industries
- Free access of DRDO patents to industries
- Identified 108 exclusive systems for development by industry which will not be taken by DRDO
- DRDO is focused to carry out R&D work on critical & advanced technologies that industries cannot do

Anti-Drone System

DRDO has developed an anti-drone system to neutralise enemy drone attacks. The indigenous drone technology is capable of counter attacks including detection, Soft Kill (for jamming the communication links of Drone) and Hard Kill (Laser based hard kill to destroy the drone) of enemy drones. The system has already been demonstrated to the Armed Services and other internal security agencies. The indigenous DRDO Counter-Drone Technology has been transferred to BEL.

SASMOS-GKN JV in India wins contract with Saab for Boeing-Saab T-7A

Fokker Elmo SASMOS Interconnection Systems Limited (FE-SIL), the Joint Venture (JV) between GKN Aerospace and SASMOS HET Technologies Limited, located in Bangalore, India has been awarded a USD multi-million dollar contract from Saab to manufacture Electrical Interconnections Systems (EWIS) for the Boeing-Saab T-7A trainer aircraft aft-section in the advanced jet that will train the next generation of fighter and bomber pilots. Under the multi-year contract, FE-SIL will deliver the required wiring systems for the advanced aircraft's aft fuselage. This contract will strengthen FE-SIL›s relationship with Saab and Boeing, supporting them with affordable, global solutions.

Production of defence equipment in 'Make-In-India' programme

'Make in India' is implemented in defence sector through various policy initiatives which promotes indigenous design, development and manufacture of defence items. As per Defence Acquisition Procedure (DAP), priority has been accorded to capital acquisition through 'Buy (Indian-IDDM)', 'Buy (Indian)', 'Buy and Make (Indian)', 'Buy and Make' 'Strategic Partnership Model' or 'Make' categories over Buy (Global) category. Many significant projects including 155mm Artillery Gun system 'Dhanush', Bridge Laying Tank, Thermal Imaging Sight Mark-II for T-72 tank, Light Combat Aircraft 'Tejas', 'Akash' Surface to Air Missile system, Submarine 'INS Kalvari', 'INS Chennai', Anti-Submarine Warfare Corvette (ASWC), Arjun Armoured Repair and Recovery Vehicle, Landing craft utility, etc. have been produced in the country under 'Make in India' initiative of the Government in last few years.

HAL's Hindustan-228 carries out ground run and LSTT

HAL successfully carried out the Ground Run and Low Speed Taxi Trials (LSTT) of the Hindustan-228 (VT-KNR) aircraft on 15 August 2021 for DGCA 'Type Certification'. "This is a major milestone for the first fixed wing Made-in-India civil aircraft in India. It is a step forward towards strengthening regional air connectivity", stated Mr Sajal Prakash, CEO of HAL's Accessories Complex. Mr Indranil Chakraborty, Director, DGCA said the type certification would also enable HAL to get the international certification for the aircraft. The aircraft complies with the latest FAR 23 certification requirements.

The Hindustan-228 is a 19-seat multirole utility aircraft built for various applications such as VIP transport, passenger transport, air ambulance, flight inspection roles, cloud seeding, and recreational activities like para jumping, aerial surveillance, photography and cargo applications.

On 4 August, HAL announced that the HTT-40 had completed spin certification flight testing. It has already demonstrated ten turn spins and ready for operational clearance.

Mahindra Defence's Integrated ASW Defence Suite for IN

The Ministry of Defence (MoD) has awarded a major contract to Mahindra Defence Systems Limited (MDS) worth Rs 1349.95 Cr for the manufacturing of Integrated Anti-Submarine Warfare Defence Suite (IADS) for modern warships of Indian Navy. IADS is a high-end underwater equipment that uses latest technology. It is designed to detect and protect warships from underwater threats. It is a versatile system capable of operations from all sizes of warships - small, medium, and large. The complex array of sensors in water undertakes surveillance, and provides inputs for signal processing and analysis, to enable necessary action. Mahindra Defence would be supplying 14 IADS Systems for the Indian Navy warships.

L&T-built 7th OPV, ICGS Vigraha commissioned

L&T-built Offshore Patrol Vessel ICGS Vigraha was commissioned into the Indian Coast Guard (ICG) by Mr. Rajnath Singh, Defence Minister of India at Chennai on 28 August, showcasing its commitment to Aatmanirbhar Bharat by completing delivery of all seven OPVS ahead of contractual schedule. ICGS Vigraha is the last vessel in the series of seven Offshore Patrol Vessels (OPVs) built by L&T under a MoD contract signed in 2015. The ICGS Vigraha is about 98 metres long, 15 metres wide, has 3.6 metres draught, with 2140 tonnes displacement and a range of 5000 NM. It can attain a sustained speed of up to 26 knots.

Keel laying ceremony for ASW and SVL

Keels of the first warship of the Anti-Submarine Warfare Shallow Water Craft (ASW SWC) project and the third warship of Survey Vessel Large (SVL) project for the Indian Navy were laid virtually on 6 August 2021 by VAdm SN Ghormade, Vice Chief of Naval Staff. The ships are being built by GRSE as part of the indigenous shipbuilding programme for construction of eight ASW SWC and four SVL for the Indian Navy. The ships are partly being

built under a unique Public Private Partnership model by GRSE at L&T Shipyard, Kattupalli. The Keel Laying is a major milestone activity in the shipbuilding process and indicates the amalgamation of various blocks towards construction of a ship.

DRDO flight-tests MPATGM for minimum range

Defence Research and Development Organisation (DRDO) successfully flight-tested indigenously developed low weight, fire and forget Man Portable Antitank Guided Missile MPATGM on 21 July 2021. The missile was launched from a man portable launcher integrated with thermal site and the target was mimicking a tank. The missile hit the target in direct attack mode and destroyed it with precision. The test has validated the minimum range successfully. All the mission objectives were met. The missile has already been successfully flight tested for the maximum range.

DRDO flight-tests surface-to-air missile Akash-NG

Defence Research & Development Organisation (DRDO) successfully flight-tested the New Generation Akash Missile (Akash-NG), a surface-to-air Missile from Integrated Test Range (ITR) off the coast of Odisha on 21 July 2021. The flight trial was conducted at around 12:45 PM from a land-based platform with all weapon system elements such as Multifunction Radar, Command, Control & Communication System and launcher participating in deployment configuration. The launch was witnessed by the representatives of Indian Air Force. In order to capture flight data, ITR deployed a number of range stations like, Electro Optical Tracking System, Radar and Telemetry.

India for Harpoon Joint Common Test Set (JCTS)

The US State Department has made a determination approving a possible Foreign Military Sale to the Government of India of Harpoon Joint Common Test Set (JCTS) and related equipment for an estimated cost of $82 million. The Government of India has requested to buy one Harpoon Joint Common Test Set (JCTS). Also included is one Harpoon Intermediate Level maintenance station; spare and repair parts, support, and test equipment; publications and technical documentation; personnel training; US Government and contractor technical, engineering, and logistics support services; and other related elements of logistics and programme support.

US Special Operations Command leadership visits India

The Commander of US Special Operations Command, Gen. Richard D. Clarke, visited with Indian defence officials and US Embassy New Delhi. The meetings were part of a routine visit through multiple countries in Asia. Clarke began the trip honoring India's fallen service members by laying a wreath at the National War Memorial. After the ceremony, Clarke met with Indian defence officials. They discussed ways India and the United States could continue working together to improve defence partnerships and grow interoperability.

DRDO develops advanced chaff technology for IAF

Defence Research & Development Organisation (DRDO) has developed an Advanced Chaff Technology to safeguard fighter aircraft of the Indian Air Force (IAF) against hostile radar threats. Defence Laboratory Jodhpur, a DRDO laboratory developed the advanced chaff material and chaff cartridge-118/I in collaboration with High Energy Materials Research Laboratory (HEMRL), a Pune based laboratory of DRDO, meeting qualitative requirements of IAF. The Indian Air Force has started the process of induction of this technology after completion of successful user trials.

Tata Boeing Aerospace delivers 100th fuselage for AH-64 Apache

Tata Boeing Aerospace Limited (TBAL) has announced the delivery of the 100th fuselage for the AH-64 Apache combat helicopter to Boeing from its state-of-the-art manufacturing facility in Hyderabad. The fuselage will be transported to Boeing's AH-64 Apache manufacturing facility in Mesa, AZ, for integration into the final assembly line. Tata Boeing Aerospace, Boeing's first equity joint venture in India, is the result of a 2015 partnership agreement with TASL. Spread over 14,000 square meters, the state-of-the-art facility has been producing aero-structures for Boeing's AH-64 Apache helicopter, including fuselages, secondary structures and vertical spar boxes for customers worldwide.

Mahindra Aerostructures to manufacture Boeing 737 components

Mahindra Aerostructures Pvt Ltd (MASPL) has been awarded a contract for manufacturing and supply of the Boeing 737 inlet outer barrel components and sub-assemblies at the MASPL facility in Narsapura, near Bengaluru, India. Production begins in 2023. Commenting on the new contract, Mr. S P Shukla, Member of the Group Executive Board of Mahindra Group, and Group President, Defence, Aero & Agri sector, observed, "We are privileged to be awarded this prestigious contract for the 737, which is another step in our journey with Boeing to support the Atmanirbhar Bharat initiative of the Indian Government."

Tata Advanced Systems to manufacture Boeing 737 fan cowls

Tata Advanced Systems Ltd. (TASL) has been awarded a contract for manufacturing and supply of the Boeing 737 fan cowl at the TASL facility in Hyderabad. TASL will supply 50% of the monthly 737 fan cowl requirements from FY 2025. Fan cowl doors provide an aerodynamic surface over the fan case of the engine between the inlet and the thrust reverser and protect engine mounted components and accessories. There are two fan cowl doors (left and right) around each engine that can be opened to provide access for service and maintenance of the engine components and accessories on the fan case of the engine.

ISRO's GSLV-F10 lifted off successfully from Satish Dhawan Space Centre, Sriharikota on 12 August 2021….however, while performance of 1st and 2nd stages was normal, "the Cryogenic Upper Stage ignition did not happen due to technical anomaly. The mission couldn't be accomplished as intended"

Indian Navy contracts BEL for naval anti drone system

The Indian Navy has signed a contract with Bharat Limited (BEL) for supply of the first indigenous, comprehensive Naval Anti Drone System (NADS) with both hard kill and soft kill capabilities. The contract was signed by Indian Navy and BEL, at New Delhi, in the presence of senior naval officers and DRDO representatives. NADS, developed by DRDO and manufactured

by BEL, is the first indigenously developed anti-drone system to be inducted into the Indian Armed Forces. The Naval Anti Drone System can instantly detect and jam micro drones and uses a laser-based kill mechanism to terminate targets. Both the static and mobile versions of NADS will be supplied to the Indian Navy within a short time from the signing of contract.

Rolls-Royce and HAL for Adour engine parts to be 'Made in India'

Rolls-Royce and Hindustan Aeronautics Limited (HAL) have signed an agreement to 'Make in India' engine parts for Adour engines, to support Rolls-Royce's international defence customer base. Through this partnership, Rolls-Royce aims to strengthen the ecosystem for Adour engines in India by building on HAL's existing capabilities for manufacturing and supporting the Adour engines for Indian customers over several decades. This follows the Memorandum of Understanding (MoU) signed by Rolls-Royce and HAL during the Aero India 2021 event to establish an Authorised Maintenance Centre for Adour at HAL to support international military customers and operators.

Multi-Mode Hand Grenades handed over to Indian Army

The first batch of Multi-Mode Hand Grenades (MMHG), manufactured by Economic Explosives Limited (EEL) following Transfer of Technology from Terminal Ballistics Research Laboratory of Defence Research & Development Organisation (DRDO), was handed over to the Indian Army in the presence of Raksha Mantri Rajnath Singh in Nagpur, Maharashtra on 24 August 2021.

India & US sign Project Agreement for ALUAVs

Ministry of Defence and US Department of Defence signed a Project Agreement (PA) for Air-Launched Unmanned Aerial Vehicle (ALUAV) under the Joint Working Group Air Systems in the Defence Technology and Trade Initiative (DTTI). The PA for ALUAV falls under the Research, Development, Testing and Evaluation (RDT&E) Memorandum of Agreement between Ministry of Defence and US Department of Defence, which was first signed in January 2006 and renewed in January 2015.

The PA outlines the collaboration between Air Force Research Laboratory, Indian Air Force, and Defence Research and Development Organisation towards design, development, demonstration, testing and evaluation of systems to co-develop an ALUAV Prototype. The Aeronautical Development Establishment (ADE) at DRDO and the Aerospace Systems Directorate at the Air Force Research Laboratory (AFRL), along with the Indian and US Air Forces, are the principal organisations for execution of PA.

ALSIM and Three DIS contract for 3 FNPT II MCC simulators

ALSIM Simulateurs S.A.S. has been awarded a contract by the Airports Authority of India (AAI) for the design and production of three Flight Simulator Training Device (FSTD) simulators of EASA Flight Navigation and Procedure Trainer (FNPT) Multi Crew Coordination (MCC) level II types for Single Aisle aircraft. The Factory Acceptance will be performed in Nantes, France and the Installation/Commission at AAI in India (Three AAI Training Centres: CATC Prayagraj, HTC Hyderabad and NIATAM Gondia). The project includes three years warranty followed by another three years of Annual Maintenance Contract.

Financial powers to Armed Forces for revenue procurement

Raksha Mantri Rajnath Singh released in New Delhi on 7 September an order on Delegation of Financial Powers to Defence Services (DFPDS) 2021, providing enhanced delegation of Revenue Procurement powers to the Armed Forces. The DFPDS 2021 aims to empower field formations; focus on operational preparedness; promote ease of doing business and enhance jointness among the Services. The enhanced delegation of Financial Powers to functionaries in Service Headquarters and lower formations would result in quicker decision making at all levels leading to better planning and operational preparedness of the Services in a quicker time frame and optimum utilisation of resources.

Pacific Air Chiefs Symposium 2021 (PACS-21)

Air Chief Marshal RKS Bhadauria, Chief of the Air Staff (CAS) attended the Pacific Air Chiefs Symposium 2021 (PACS-21) at Joint Base Pearl Harbor-Hickam, Hawaii from 30 August to 2 September 2021.

The event themed «Enduring Cooperation towards Regional Stability» was attended by Air Chiefs from countries in the Indo-Pacific region. CAS was nominated as the Dean for the Symposium. The Symposium saw deliberations through panel discussions, table top exercises and keynote addresses on topics ranging from aspects of Regional Security and the significance of Air Domain Awareness, to cooperation amongst Air Forces for Humanitarian and Disaster Relief Operations.

CAS visit to Bengaluru

Air Chief Marshal RKS Bhadauria, CAS, visited IAF units and flight test establishments/ facilities of DRDO and HAL at Bengaluru on 23 and 24 August. On arrival, CAS was received by AVM Jeetendra Mishra VSM, Commandant Aircraft and Systems Testing Establishment (ASTE). During his visit to ASTE, CAS was given an overview of ongoing projects and briefed on progress of operational trials. During his interaction with personnel, CAS spoke of the unique and challenging role of ASTE, noted its laudable achievements and reemphasised the need for staying ahead of the curve in order to leverage its expertise in delivering the requirements of IAF Operational units.

As part of the visit, CAS met and interacted with the test crew and engineers of Aeronautical Development Agency (ADA), DRDO and Hindustan Aeronautics Limited (HAL). During his visit to Bengaluru, CAS flew in an IOC LCA Tejas.

Commanders' Conference at Eastern Air Command

Air Chief Marshal RKS Bhadauria visited Headquarters Eastern Air Command (EAC) at Shillong from 26 to 27 August 2021 for the Commanders› Conference of EAC. On arrival, CAS was received by Air Marshal Amit Dev, Air Officer Commanding-in-Chief, Eastern Air Command. The two day conference reviewed the progress of operational goals set for the Command and highlighted discussions on ways and means to optimise full spectrum combat readiness. While addressing the Commanders, CAS highlighted the increasing importance of Eastern Air Command in the overall strategic perspective. He expressed satisfaction at the buildup and strengthening of capability and infrastructure at various stations including Advanced Landing Grounds (ALGs) in the Eastern sector.

Commanders' Conference, South Western Air Command

Air Chief Marshal RKS Bhadauria visited Gandhinagar on the occasion of Commanders› Conference at South Western Air Command (SWAC) on 17 and 18 August 2021. The conference brought together Commanders from Air Force Stations in SWAC Area of Responsibility (AOR) for an operational review of missions and tasks. On arrival, CAS was received by Air Marshal Sandeep Singh, Air Officer Commanding-in-Chief South Western Air Command. CAS placed a wreath at the Command War Memorial and was presented with a ceremonial Guard of Honour.

Commanders' Conference at Headquarters Training Command, IAF

Air Chief Marshal RKS Bhadauria visited Headquarters Training Command Bengaluru to attend the Training Command Commanders' Conference held on 28 and 29 July 2021. In his address to the Commanders, CAS highlighted the need to be vigilant and remain poised to undertake all operational tasks assigned to the IAF. CAS commended the hard work put in by all the training academies and stations under Training Command for ensuring timely completion of training commitments, despite severe constraints placed due to second wave of COVID.

Maintenance Command Commanders' Conference

Air Chief Marshal RKS Bhadauria attended the Commanders' Conference of Maintenance Command at Vayu Sena Nagar, Nagpur on 11 and 12 August 2021. CAS on arrival was received by Air Marshal Shashiker Choudhary, AOC-in-C MC. The two day event was attended by Commanders of Base Repair Depots, Equipment Depots and other Stations/ Units under MC, who reviewed ongoing projects and took stock of goals and tasks for MC in the year ahead.

Fleet Award Ceremony – Western Naval Command

The Fleet Award Ceremony each year marks the end of the operational cycle of the Western Fleet, the Sword Arm of the Western Naval Command. The ceremony was held on 23 July 2021 at Mumbai after a gap of a year due to the COVID 19 pandemic. This year, the ceremony was hosted by Rear Admiral Ajay Kochhar, Flag Officer Commanding Western Fleet. The ceremony marked the operational achievements of the Fleet from April 2020 to March 2021. The event was attended by Flag Officers of Western Naval Command with Vice Admiral R Hari Kumar, Flag Officer Commanding -in- Chief, Western Naval Command as the Chief Guest.

Airborne Tacticians join Naval Air Arm

16 officers of the Indian Navy and three officers of Coast Guard graduated as Observers and were awarded wings at a ceremony held on 5 August 2021at INS Garuda, Kochi. Two officers graduated as Qualified Navigation Instructors (QNIs) and were awarded instructional torches. Rear Admiral AN Pramod, Deputy Commandant, Indian Naval Academy was the chief guest for the event and awarded the 'Instructor Badge' to QNIs and the coveted 'Golden wings' to the passing out officers.

The officers of the 10th QNI course were trained at instructional techniques on ground and during flying, as well as were provided in–depth knowledge of tactics and sensor exploitation. The officers of the 93rd regular course and 24th SSC observer course were trained in air navigation, flying procedures, tactics employed in air warfare, anti-submarine warfare and exploitation of airborne avionic systems. These officers would serve on-board maritime reconnaissance and anti-submarine warfare aircraft of the Indian Navy and Coast Guard.

Handing over ceremony of interim lease Passenger Variant Dornier

An official ceremony was conducted at Maritime Air Squadron of National Coast Guard, Mauritius on 13 September 2021 for handing over of the Passenger Variant Dornier (PVD). The aircraft has been presented to the Mauritius Police Force (MPF) by the Indian Navy, on lease. The Minister of Land Transport and Light Rail, Minister of Foreign Affairs, Regional Integration and International Trade, Honourable Alan Ganoo, the High Commissioner of India, Smt Nandini K Singla, the Commissioner of Police and various other dignitaries were present for the ceremony.

IAF Chief visits Israel

On 6 August, Air Chief Mshl RKS Bhadauria, CAS called on Maj Gen Amikam Norkin, Cdr Israeli Air Force and held wide-ranging discussions on all bilateral Air Force interactions. CAS flew a sortie along with the Major General and was given an overview of Israeli Air Force's operational environment. CAS had meetings with DG MoD and Chief of the Gen Staff on matters of mutual interest and bilateral defence cooperation. As part of the visit, the CAS and Cdr of the Israeli Air Force visited the "Yad Vashem" and paid homage at the memorial. The Chiefs also laid wreaths at the Cemetery for Indian soldiers in Talpioth, Jerusalem.

India's first Drone Medicine Delivery project launched

Mr. Jyotiraditya M Scindia, Union Minister of Civil Aviation, launched ‹Medicine From The Sky, Beyond-Visual-Line-Of-Sight› at a function held at Vikarabad, 75 km away from Hyderabad in Telangana on 11 September. Telangana's 'Medicines From The Sky› project can be a game-changer in using drones for healthcare. The project is the first of its kind in India. It is also a potential game-changer for using drones in the civilian sector in India.

IndiGo celebrates its 15th Anniversary

To celebrate fifteen successful years of flying, IndiGo announced a 3-Day Special Sale offering all-inclusive fares starting from INR 915 on its domestic and international connections. With its

fleet of 270+ aircraft, the airline is operating around 1000 daily flights and connecting 67 domestic destinations and 24 international destinations.

IndiGo announces Gwalior as its 70th domestic destination

In its bid to strengthen regional connectivity, IndiGo, India's leading carrier, announced Gwalior as 70th domestic destination on the 6E network. The airline will operate ATR aircraft for direct flights from Gwalior to Delhi and Indore. Direct connections with Gwalior will also strengthen the city's overall air accessibility across India through 6E network. These flights will operate from and to Terminal 2 in Delhi.

IAG Cargo record uplift from Bangalore to London

IAG Cargo, the cargo division of International Airlines Group (IAG) uplifted 48,500 kgs of cargo on a cargo-only flight from Bangalore, India to London-Heathrow operated by a British Airways A350-1000 aircraft in July – a record for IAG Cargo for this aircraft from India.

SpiceJet finalises settlement with major lessor

(Photo: Chris Jilli)

SpiceJet has entered into a settlement with Avolon, a major lessor of MAX aircraft, paving the way for the airline's 737 MAX aircraft to start to return to service. The airline expects to start operations of MAX aircraft around the end of September 2021 subject to regulatory approvals.

SpiceJet announces transfer of its logistics business to SpiceXpress

SpiceJet has announced the transferring of its cargo and logistics services on a slump sale basis along with all related assets and liabilities, including, know-how, trademark, licenses, franchises, customer contracts, distribution network etc. to its subsidiary SpiceXpress and Logistics Pvt. Limited (SpiceXpress) subject to the approval of shareholders and also such other approvals as may be required.

Air Asia India is launch customer of Airbus' SHM solution in South Asia

AirAsia India has become the launch customer of the Airbus Skywise Health Monitoring (SHM) digital solution in the South Asia region. As part of the ten-year contract, the airline will also adopt Airbus' Skywise Core aviation data integration platform. AirAsia India will use both solutions for its A320 fleet. Airbus› SHM will support the airline›s maintenance and engineering teams by enabling real-time management of aircraft events and troubleshooting. This will help the airline save time and reduce the cost of unscheduled aircraft maintenance.

Airbus' UP42 partners with HyperVerge for AI-based satellite imagery analytics

UP42, a geospatial developer platform and marketplace wholly owned by Airbus, has partnered with Indian startup HyperVerge Inc. to offer satellite imagery services using Artificial Intelligence (AI)-based change detection algorithms. This is the 11th successful partnership industrialised by Airbus Bizlab in India and the second partnership between HyperVerge and an Airbus entity.

APPOINTMENTS

Vice Admiral SN Ghormade assumes charge as Vice Chief of the Naval Staff

Vice Admiral SN Ghormade assumed charge as the Vice Chief of Naval Staff at a formal ceremony held at South Block, New Delhi. Vice Admiral SN Ghormade is an alumni of the National Defence Academy (NDA), Khadakwasla, Naval Staff College at the United States Naval War College, Newport, Rhode Island, and the Naval War College, Mumbai. The Flag Officer was commissioned in the Indian Navy on 1 January 1984 and is a Navigation and Direction specialist.

Lt Gen Tarun Kumar Chawla takes over as Director General of Artillery

Lt Gen Tarun Kumar Chawla assumed the appointment of the Director General of Artillery on 1 August 2021. He is an alumnus of St Thomas High School, Dehradun and National Defence Academy, Khadakwasla. He was commissioned into a Field Regiment of Artillery in June 1984 and has served across a wide spectrum of terrain profiles and tenanted a host of command, staff and instructional appointments. He commanded an Artillery Regiment both in the Western and Eastern sectors.

Air Marshal Suraj Kumar Jha assumes charge as Air Officer in Charge Personnel

Air Marshal Suraj Kumar Jha assumed the appointment of Air Officer in Charge Personnel at Air HQ on 1 August. The Air Marshal was commissioned in the Fighter stream of IAF on 8 June 1984. In a career spanning 37 years, the Air Officer has flown over 2900 hours, including operational flying on a wide variety of fighter aircraft in the inventory of IAF.

Sunny Guglani to head Airbus Helicopters for India & South Asia

Airbus has appointed Sunny Guglani as Head of Airbus Helicopters for India and South Asia. He assumed charge on 16 August 2021 and will be based in New Delhi. Guglani will be responsible for growing Airbus' civil, parapublic and defence helicopter business in the region, including aftermarket services. Guglani has been with the company for more than seven years. In his past roles, he has worked in the Airbus CEO's office and led the A380 marketing team based in Toulouse, France. He previously headed corporate communications for India and South Asia region before moving to Europe.

Amit Banerjee takes charge as CMD of BEML

Mr. Amit Banerjee has taken over as Chairman & Managing Director of BEML Limited, a public sector undertaking under Ministry of Defence. Mr. Banerjee is a graduate in Mechanical Engineering from IIT (BHU), Varanasi. He joined as Asst Engineer and has a vast experience of over 37 years in R&D and manufacturing functions. He has worked for indigenous development of Metro Cars for Delhi, Jaipur, Kolkata, Bangalore and Mumbai, Stainless-Steel EMU & Intermediate Metro Cars, Catenary Maintenance Vehicle and PMS Bridge for Indian Army among others. Prior to assuming the present position, he was Director (Rail & Metro) BEML.

Commencement of sea trials of IAC (P71) 'Vikrant'

Indigenous Aircraft Carrier (IAC) 'Vikrant' designed by Indian Navy's Directorate of Naval Design (DND) is being built at Cochin Shipyard Limited (CSL), a Public Sector Shipyard under Ministry of Shipping (MoS). IAC is a leading example of the nation's quest for "Atma Nirbhar Bharat" with more than 76% indigenous content. This is the maiden attempt of the Indian Navy and Cochin Shipyard to indigenously design and build an aircraft carrier.

The Indigenous Aircraft Carrier is 262 m long, 62 m at the widest part and height of 59 m including the superstructure. There are 14 decks in all, including five in the superstructure. The ship has over 2,300 compartments, designed for a crew of around 1700 people, including specialised cabins to accommodate women officers. The ship has been designed with a very high degree of automation for machinery operation, ship navigation and survivability, 'Vikrant' has a top speed of around 28 knots and cruising speed of 18 knots with an endurance of about 7,500 nautical miles. The ship can accommodate an assortment of fixed wing and rotary aircraft.

Most of the ship construction activities have been completed and the ship has entered the trials phase. Readiness of ship's Propulsion and Power Generation equipment/systems was tested in harbour as part of Basin Trials in November 2020. Progress of construction of the Carrier was reviewed by the Raksha Mantri during his visit to the ship on 25 June 2021. Though the commencement of Sea Trials was delayed due to the 2nd wave of COVID, with concentrated and dedicated efforts of large number of workmen, OEMs, engineers, overseers, inspectors, designers and the ship's crew, who had put their heart and soul towards the ship's readiness for sea trials. This is a major milestone activity and historical event and reaching this milestone is significant as they have been achieved barring the current pandemic challenges and

imponderables. During the maiden sailing, ship's performance, including hull, main propulsion, PGD and auxiliary equipment would be closely watched.

With the delivery of IAC, India would join a select group of nations with the capability to indigenously design and build an aircraft carrier, which will be a real testimony to the 'Make in India' thrust of the Indian Government.

The indigenous construction of the carrier is a shining example in the Nation's quest for 'Atma Nirbhar Bharat' and 'Make in India Initiative'. This has led to growth in indigenous design and construction capabilities besides development of large number of ancillary industries, with employment opportunities for 2000 CSL personnel and about 12,000 employees in ancillary industries. Over 76% indigenous content towards procurement of equipment, besides work by CSL and their subcontractors is being directly invested back into the Indian economy. Around 550 Indian firms including about 100 MSMEs are registered with CSL, who are providing various services for construction of IAC.

Indian Navy's ship building programme is rightly poised to provide requisite 'Economic Stimulus', with 44 ships and submarines on order being built indigenously.

Courtesy: Indian MoD

IAC returns after successful maiden sea voyage

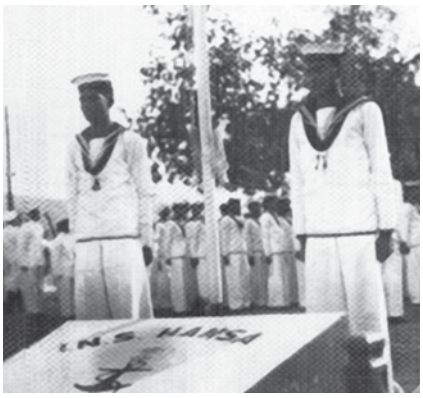
On 8 August 2021, the Indigenous Aircraft Carrier (IAC) 'Vikrant' successfully accomplished its maiden sea voyage for which she had sailed on 4 August 2021 from Kochi. Trials progressed as planned and system parameters proved satisfactory. The carrier will continue to undergo series of sea trials to prove all equipment and systems prior handing over the vessel to the Indian Navy.

During the maiden sailing, ship's performance, including hull, main propulsion, power generation and distribution (PGD) and auxiliary equipment were tested. The trials, which were reviewed by Vice Admiral AK Chawla, Flag Officer Commanding-in-Chief Southern Naval Command on the last day, have progressed as planned and system meters have proved satisfactory.

INS Hansa marks Diamond Jubilee

INS Hansa, the Indian Navy's premier air station, celebrated its Diamond Jubilee on 5 September 2021. The Naval Jet Flight set up at Coimbatore in 1958 with Sea Hawk, Alize and Vampire aircraft, was later commissioned as INS Hansa on 5 September 1961. After the liberation of Goa, Dabolim airfield was taken over by the Navy in Apr 1962 and INS Hansa shifted to Dabolim June 1964.

Commissioned as a modest air station with only a few aircraft, INS Hansa has increased its prowess over the last six decades and is presently operating over 40 military

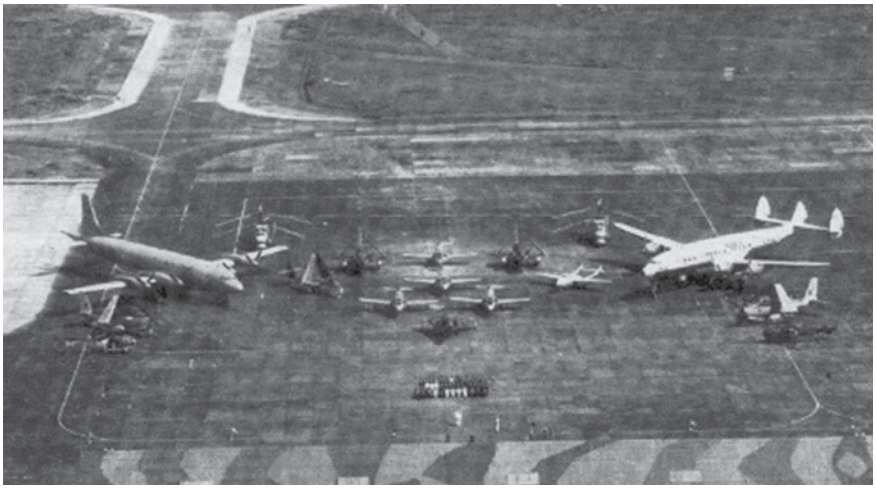


aircraft, clocking an average yearly flying of over 5000 hours. The air station also supports civil aviation by handling domestic and international flights 24x7, with an average of 29,000 flights a year.

INS Hansa is the abode of the Indian Navy's frontline air squadrons - INAS 310 'Cobras' with Dornier-228 aircraft, INAS 315 'Winged Stallions' with the long range maritime patrol aircraft IL-38SD, INAS 339 'Falcons' with the airborne early warning Kamov-31 helicopter; INAS 303 'Black Panthers' and INAS 300 ' White Tigers' with the supersonic carrier-borne MiG-29K fighters, and INAS 323 'Harriers' with ALH Mk III helicopters. The air station will soon operate the Boeing P8I long range maritime reconnaissance aircraft with the commissioning of INAS 316.

Cmde Ajay D Theophilus, Commanding Officer, INS Hansa stated, "Over the years, the base has represented a crucial segment of the Navy's combat power. Aircraft from Hansa augment the security of entire western seaboard significantly, including offshore assets, and undertake extensive surveillance to neutralise threats at and from the sea. The base has also provided substantial aid to civil authorities in the form of search and rescue, HADR, flood relief, community activities and numerous Vande Bharat flights".

INS Hansa was host to the prestigious event of presentation of President's Colour to naval aviation by the President of India on 6 September 2021. The event coincided with the Diamond Jubilee of INS Hansa and the liberation of Goa.



President's Colour presented to Naval Aviation

Mr. Ram Nath Kovind, the President of India and the Supreme Commander of Indian Armed Forces, presented the President›s Colour to Indian Naval Aviation at INS Hansa, Goa on 6 Sep 2021. To mark the momentous occasion, a ceremonial parade with a 150-men Guard of Honour was presented to the President. Mr. PS Sreedharan Pillai, the Governor of Goa; Dr Pramod Sawant, Chief Minister of Goa; Mr. Shripad Yesso Naik, Minister of State for Tourism, Ports Shipping and Waterways; Admiral Karambir Singh, Chief of Naval Staff; Vice Admiral R Hari Kumar, Flag Officer Commanding-in-Chief Western Naval Command and Rear Admiral Philipose G Pynumootil, Flag Officer Naval Aviation along with other civil and military dignitaries attended the ceremony.

The President›s Colour is bestowed on a military unit, in recognition of exceptional service rendered to the Nation, both in peace and in war. Naval Aviation has distinguished itself with notable and gallant service to our Nation over the past seven decades. The Indian Navy was the first Indian Armed Force, to receive the President›s Colour, from Dr Rajendra Prasad, the then President of India on 27 May 1951. Subsequent recipients of the President›s Colour in the Navy include Southern Naval Command, Eastern Naval Command, Western Naval Command, Eastern Fleet, Western Fleet, Submarine Arm, INS Shivaji and the Indian Naval Academy.

Award of the President›s Colour to Indian Naval Aviation, is in recognition of the yeoman service rendered both during peace and combat. The arm came into being with acquisition of the first Sealand aircraft on 13 Jan 1951 and commissioning of INS Garuda, at Kochi on 11 May 1953. Today, Naval Aviation boasts of nine Air Stations and three Naval Air Enclaves, along the Indian coastline and the Andaman and Nicobar Islands. Over the past seven decades, it has transformed into a modern, technologically advanced and highly potent force, with more than 250 aircraft comprising fighters, maritime reconnaissance aircraft, helicopters and remotely piloted aircraft (RPA). Today, Naval Aviation assets are capable of undertaking missions along the entire gamut of military operations. Naval Aviation is a vital component of the main roles of Indian Navy - Military, Diplomatic, Constabulary and Benign.

Speaking on the occasion, the President recalled the glorious contribution of INS Vikrant with its integral aircraft, which played a crucial role in liberation of Bangladesh in 1971. The President added that, naval aircraft have also been at the forefront of numerous peacetime as well as Humanitarian Assistance and Disaster Relief operations, providing relief not only to our countrymen but also to friendly foreign nations. The President lauded the indigenisation efforts of the Indian Navy in keeping with the *Atma Nirbhar Bharat* vision of the Government. The President also made a mention of the significant progress made in aviation technology, facilitation of state-of-the-art indigenous weapons, sensors and data suites for naval aircraft.

The President congratulated the officers and sailors on the momentous occasion and added that, Naval Aviation had come of age with the perseverance of the national leadership. He also congratulated all veteran and serving Naval Aviators, for their selfless service to the Nation.

Indian Naval Aviation came into being with acquisition of the first Seal and aircraft on 13 January 1951 and commissioning of INS Garuda, the first Naval Air Station, on 11 May 1953. Arrival of the armed Firefly aircraft in 1958 added an offensive punch, and the naval aviation steadily expanded its inventory to become an integral part of a formidable Navy. The year 1959 saw the commissioning of Indian Naval Air Squadron (INAS) 550 with 10 Seal and, 10 Firefly and three HT-2 aircraft. Over the years, a variety of rotary wing platforms have been added as well, ranging from the Alouette, the S-55, Seaking 42A and 42B; the Kamov 25, 28 and 31; the UH3H; the Advanced Light Helicopter and the latest in the line, the MH60R. Maritime reconnaissance (MR) also grew steadily with induction of the Super-Constellation from the Indian Air Force in 1976, the IL-38 in 1977 and the Tu-142M in 1989. Induction of the Dornier 228 in 1991 and the state-of-the-art Boeing P 8I aircraft in 2013 marked the entry of modern high-performance MR aircraft.

The world witnessed the Carrier arm of Indian Naval Aviation coming of age with the induction of INS Vikrant, the first aircraft carrier, in 1957 and integral Sea Hawk and Alize Squadrons subsequently. INS Vikrant with its aircraft played a crucial role in the liberation of Goa in 1961 and again in the 1971 Indo-Pak war, where its presence on the Eastern seaboard proved decisive. Induction of INS Viraat along with legendary Sea Harriers in the mid-1980s strengthened carrier operations of the Navy, which transformed into a reckonable force with the arrival of MiG-29Ks on the INS Vikramaditya in the last decade. The Indian Navy's carrier capability received significant fillip with sea trials of the indigenously built aircraft carrier, the new avtaar of INS Vikrant, commencing recently.

Today, Indian Naval Aviation boasts of nine air stations and three naval air enclaves along the Indian coastline and the in Andaman and Nicobar Islands. Over the past seven decades, it has transformed into a modern, technologically advanced and highly potent force with more than 250 aircraft comprising carrier-borne fighters, maritime reconnaissance aircraft, helicopters and remotely piloted aircraft (RPA). The Fleet Air Arm can support naval operations in all three dimensions and will remain the first responder for maritime surveillance and HADR in the Indian Ocean Region. Naval aviation has distinguished itself during operations such as Op Cactus, Op Jupiter, Op Shield, Op Vijay and Op Parakram to name a few. It has also spearheaded HADR operations on behalf of the Indian Navy, providing relief to numerous IOR nations in addition to our countrymen, Op Castor in 2004, Op Sukoon in 2006, Op Sahayam in 2017, Op Madad in 2018, Op Sahayta in 2019 and the recently conducted rescue operations off Mumbai during Cyclone Tauktae in May 2021 being examples.

Naval Aviation has been at the forefront in inducting women into the fighting arm of the Navy, and making them work shoulder to shoulder with their male counterparts. Naval Aviators have been decorated with one Mahavir Chakra, six Vir Chakras, one Kirti Chakra, seven Shaurya Chakras, one Yudh Seva Medal and a large number of Nao Sena Medals (Gallantry) over the years. Award of President's Colour is testimony to the high professional standards and stellar operations performance of Naval Aviation, which has distinguished itself in service to the nation.

56 Airbus C-295MW's cleared for the IAF

On 8 September 2021, the Indian Cabinet Committee on Security approved the procurement of fifty six C-295MW transport aircraft from Airbus Defence and Space, Spain for the Indian Air Force. C-295MW aircraft is a transport aircraft of 5-10 tonne capacity with contemporary technology that will replace the ageing Avro aircraft of IAF. The aircraft has a rear ramp door for quick reaction and para dropping of troops and cargo.

Sixteen aircraft will be delivered in flyaway condition from Spain within 48 months of signing of the contract and forty aircraft will be manufactured in India by Tata Consortium within ten years of signing of the contract. This is the first project of its kind in which a military aircraft will be manufactured in India by a private company. All fifty six aircraft will be installed with an indigenous electronic warfare suite. The project will give a boost to aerospace ecosystem in India wherein several MSMEs spread over the country will be involved in manufacturing of parts of the aircraft.

The programme will provide major boost to the Atmanirbhar Bharat Abhiyan of the Government as it offers a unique opportunity for the Indian private sector to enter into technology intensive and highly competitive aviation industry. The project will augment domestic aviation manufacturing resulting in reduced import dependence and expected increase in exports.

A large number of detail parts, sub-assemblies and major component assemblies of aero structure are scheduled to be manufactured in India. The programme will act as a catalyst in employment generation in the aerospace ecosystem of the country and is expected to generate 600 highly skilled jobs directly, over 3000 indirect jobs and an additional 3000 medium skill employment opportunities with more than 42.5 lakh man hours of work within the aerospace and defence sector of India. It will involve development of specialised infrastructure in form of hangars, buildings, aprons and taxiway. During the process of manufacturing in India, it is expected that all the suppliers of Tata Consortium who will be involved in special processes will gain and maintain globally recognised National Aerospace and Defence Contractors Accreditation Programme (NADCAP) accreditation.

Before completion of deliveries, 'D' Level servicing facility (MRO) for C-295MW aircraft are scheduled to be setup in India. It is expected that this facility will act as a regional MRO hub for various variants of C-295 aircraft. In addition, the OEM will also discharge its offset obligations through direct purchase of eligible products and services from Indian offset partners giving further boost to economy.

(All photos: Vayu)

Dynamatic to manufacture aerostructure assemblies for Boeing's F-15EX Eagle II

Dynamatic Technologies has been awarded a contract for manufacturing assemblies for Boeing's newest tactical fighter, F-15EX Eagle II. This is a first where aerostructures for the latest and most advanced F-15EX Eagle II will be made in India. This contract has given a boost to the Aatmanirbhar programme and strengthens US-India collaboration on aerospace and defence industrialisation. Dynamatic Technologies will supply the F-15EX aerostructure assembly requirements from FY 2022 and will manufacture these aerostructures from their manufacturing facility in Bengaluru, Karnataka.

Udayant Malhoutra, CEO & Managing Director, Dynamatic Technologies Limited stated, "Dynamatic has been associated closely with Boeing as a strategic tier-1 supplier partner for over a decade. The award for manufacturing aerostructures for the F-15EX Eagle II to Dynamatic is a testimony of our partnership with Boeing."

Salil Gupte, President, Boeing India stated, "We see tremendous potential for India to contribute to the global aerospace industry as an industrial and technology partner. The award of aerostructure assemblies for the latest and most advanced version of the F-15 aircraft family is a reflection of Boeing's focus on Aatmanirbhar Bharat and a testimony to the world class capability of our industrial partners in India."

Dynamatic Technologies is also partnering with Boeing to help grow the Indian aerospace and defence ecosystem with advanced manufacturing capabilities, training and skill development in alignment with the 'Skill India' initiative of the Government of India.

Dynamatic Technologies Limited designs and builds highly engineered products for automotive, aerospace, hydraulic and security applications at its state-of-the-art design, facilities in Europe and India. Dynamatic is a demonstrated leader for the development of exacting air frame structures and precision aerospace components for major global aerospace companies.

DRDO hands over MRSAM to the Indian Air Force

In a significant boost to India's defence capabilities, the first deliverable Firing Unit (FU) of Medium Range Surface to Air Missile (MRSAM) System was handed over to Indian Air Force (IAF) in the presence of Raksha Mantri Mr. Rajnath Singh at Air Force Station, Jaisalmer in Rajasthan on 9 September 2021. The MRSAM (IAF) is an advanced network centric combat Air Defence System developed jointly by Defence Research and Development Organisation (DRDO) and Israel Aerospace Industries (IAI) in collaboration with the Indian industry comprising of private and public sectors including MSMEs.

Secretary, Department of Defence R&D & Chairman DRDO Dr G Satheesh Reddy handed over the first deliverable Firing Unit to Chief of Air Staff Air Chief Marshal R K S Bhadauria in the presence of Mr. Rajnath Singh. During the event, DRDO and IAI officials demonstrated the capabilities of MRSAM system, as part of On-Site Acceptance Test (OSAT).

In his address, Mr. Rajnath Singh lauded the joint efforts of DRDO, IAI, various inspection agencies, public and private industry partners in developing, what he termed, one of the best state-of-the-art missile systems in the world. "With the handing over of MRSAM system to IAF, we have taken a giant leap towards achieving 'Aatmanirbhar Bharat' as envisioned by our Prime Minister Mr. Narendra Modi. It will prove to be a game changer in the air-defence-system," he said.

Shri Rajnath Singh reaffirmed the Government's commitment to bolster the technological base through indigenous research, design and development, with focus on 'Make in India, 'Make for the world'. He highlighted that close cooperation between technology partners and friendly countries has led to rapid progress towards realising this vision and development of MRSAM is a great example of such collaborative effort.

The Raksha Mantri described the development of MRSAM system as a shining example of the close partnership between India and Israel, adding that handing over of the system to IAF has taken this decades-old friendship to greater heights. It has played an important role in strengthening the defence industrial base of India and Israel, he added. On the creation of new test facilities and infrastructure in the development of this programme, Mr. Rajnath Singh said it will be helpful in producing quality products for both the countries in the future. He termed the sub-systems being manufactured for this

programme as a great example of synergy between Indian public and private sector companies.

On the occasion, the Raksha Mantri remembered former President Dr A P J Abdul Kalam, terming him a visionary who paved the way for self-reliance in defence sector, especially in the missile development programme. He said around 30 years ago Dr Kalam initiated the Integrated Missile Development Programme at a time when scientists were facing various restrictions in the field of technology. Despite all this, the Raksha Mantri said, the success of the programme not only ensured self-reliance in missile development, but also thwarted possibility of any cross-border threat.

The MRSAM system provides point and area air defence for ground assets against a wide range of threats including fighter aircraft, UAVs, helicopters, guided and unguided munitions, sub-sonic and supersonic cruise missiles etc. It is capable of engaging multiple targets at ranges up to 70 kms in severe saturation scenarios. The missile is powered by indigenously developed rocket motor and control system for achieving high manoeuvrability during the terminal phase.

The firing unit comprises of Missiles, Combat Management System (CMS), Mobile Launcher Systems (MLS), Advanced Long Range Radar, Mobile Power System (MPS), Radar Power System (RPS), Reloader Vehicle (RV) and Field Service Vehicle (FSV).

Speaking on the occasion, Chief of Air Staff Air Chief Marshal R K S Bhadauria congratulated the efforts of the entire team of MRSAM (IAF) and stated that the system would bolster the air defence capabilities of the country. DRDO Chairman Dr G Satheesh Reddy complimented the teams involved in the development of MRSAM System.

Chief of Defence Staff General Bipin Rawat, AOC-in-C SWAC Air Marshal Sandeep Singh and President & IAI CEO Mr Boaz Levy and other senior civil & military officials were also present on the occasion.

IAI congratulates the Indian Air Force and DRDO

Boaz Levy, President and CEO of IAI: "MRSAM Air & Missile Defence System is a cutting edge, innovative system and significant proof of the unique partnership and collaboration between the countries and IAI's commitment to India. The development and production of the system is fully based on the Make in India policy in partnership and collaboration between Israel and India's industries, and is a model of success of the Make in India policy for the benefit of all parties. During the last year, under strict Covid-19 conditions, teams from IAI and India worked shoulder-to-shoulder to ensure this moment, following the validation of the system's capabilities. The commitment of IAI to India, and to its defence forces, is unquestionable and we salute this partnership for many years to come."

Shareholding of Defence Related PSUs

There are nine Public Sector Undertakings (PSUs) making defence-related equipment under Department of Defence Production, Ministry of Defence as per following details:

- Hindustan Aeronautics Limited (HAL)
- Bharat Electronics Limited (BEL)
- BEML Limited (BEML)
- Bharat Dynamics Limited (BDL)
- Mishra Dhatu Nigam Limited (MIDHANI)
- Mazagon Dock Shipbuilders Limited (MDL)
- Garden Reach Shipbuilders & Engineers Limited (GRSE)
- Goa Shipyard Limited (GSL)
- Hindustan Shipyard Limited (HSL)

The details of Defence PSUs making defence-related goods in which Government has already decreased its shareholding in the last three years, are as follows:

S. No.	Name of Defence PSUs under Department of Defence Production, MoD, in which Government has decreased its shareholding in the last three years	Percentage of Government of India Shareholding as on 31.03.2018	Percentage of Government of India Shareholding as on date
1.	Hindustan Aeronautics Limited (HAL)	89.97	75.15
2.	Bharat Electronics Limited (BEL)	66.79	51.14
3.	Bharat Dynamics Limited (BDL)	87.75	74.93
4.	Mishra Dhatu Nigam Limited (MIDHANI)	100	74
5.	Garden Reach Shipbuilders & Engineers Limited (GRSE)	100	74.50
6.	Mazagon Dock Shipbuilders Limited (MDL)	100	84.83
7.	BEML Ltd	54.03	Strategic disinvestment underway

Disinvestment in Defence PSUs is done to bring in financial autonomy, facilitate people's ownership and improve their efficiency through accountability towards its stake holders. It also provides an opportunity to the citizens to participate in the wealth and prosperity of these organisations.

To meet the challenges in the defence sector, including the emergencies, the Government has taken multi-pronged actions for Indigenisation and manufacturing of defence items within the country. Two (2) Positive lists (erstwhile Negative list) of Indigenisation comprising of 209 items have been notified for placing these items under import embargo with specified timelines. Further, Defence PSUs under Department of Defence Production have modernised their infrastructure, created new capacities and have developed a robust supply chain in the form of extensive vendor base to ensure production of defence equipment. Additionally, to enhance functional autonomy, efficiency, unleash new growth potential and innovation in Ordnance Factories, Government has approved corporatisation of Ordnance Factory Board into 7 Defence PSUs. Besides this, there are nine DPSUs including shipyards and 542 defence licensees in the private sector which contribute to the defence production within the country to meet emergency requirements.

Courtesy: Indian MoD

Increase in budget for the Indian Army

Details of BE allocation under Non-Salary (Revenue) Budget and Capital Acquisition Budget of the Indian Army during the five year period of 2017-18 to 2021-22 and previous five year period of 2012-13 to 2016-17 is as under (in Rs./crores):

Year	Non-Salary (Revenue)	Capital Acquisition	Total	% age increase over the previous year
2012-13 to 2016-17	1,30,852.23	91,576.35	2,22,428.58	-
2017-18 to 2021-22	1,62,801.25	1,21,222.56	2,84,023.81	27.69

The above figures indicate that there has been substantial increase of 27.69% in the five year period of 2017-18 to 2021-22 over 2012-13 to 2016-17. Further, the operational efficiency matches the technological advancement commensurately.

National War Memorial, New Delhi: an update

The construction cost towards establishing the National War Memorial is Rs 176.65 crore (Rupees One Hundred Seventy Six Crore and Sixty Five Lakhs only). Further, Bharat Electronics Limited has been nominated to execute the project of Enhancement of Digital Appeal at National War Memorial.

The online portal dedicated to the gallantry award winners has already been created during 2017-18. The online portal dedicated to the gallantry award winners has been created during 2017-18 with an estimated expenditure of Rs 7,11,500/- (Rupees Seven Lakh Eleven Thousand and Five Hundred only).

Further, Ministry of Defence has entered into an agreement with Raksha Rashtriya University (RRU) for improvement of the portal at a monthly payment of Rs. 1,59,000/- (One Lakh and Fifty Nine Thousand only). In the FY 2020-21, the expenditure was Rs. 4,77,000/- (Rupees Four Lakh and Seventy Seven Thousand only) and in FY 2021-22 till May 2021, the expenditure was Rs. 3,18,000/- (Rupees Three Lakh and Eighteen Thousand only).

The Ministry of Defence has also entered into a contract with Broadcasting Engineering Consultants India Limited (BECIL) w.e.f.. 1 May 2021 to 30 Apr 2022 at Rs. 77,172/- per month for deployment of consultant (Social Media) to assist the Ministry in enrichment of Gallantry Awards Portal.

The Ministry has introduced various modules/activities viz. option of paying tribute, taking pledge, motivational videos, information of war memorials and war histories, e-Books etc. Various public participative events viz. Quiz on Gallantry Awards, tribute competition, logo design competition, live streaming of NCC activities at statues of Awardees are also conducted from time to time. MoD have also created dedicated social media handles for publicity of activities planned on Gallantry Portal and also Youtube channel for uploading of videos relating to the Awardees.

Ministry of Defence, in coordination with National e-Governance Division (NeGD), Bhaskaracharya National Institute for Space and Geo-informatics (BISAG) (under Ministry of Electronics & Information Technology), Rashtriya Raksha University (RRU), Armed Forces and NIC, is maintaining the portal to honour the gallantry awardees.

Yamuna International Airport secures final nod on masterplan

Yamuna International Airport Pvt Ltd (YIAPL) has secured the final approval for the masterplan for Noida International Airport (NIA). The masterplan was prepared in close collaboration with aviation consultants Landrum & Brown and experts from Zurich Airport International. The approval was secured from NIAL, DGCA, AAI, BCAS and necessary environmental authorities. The Master Plan is compliant with the requirements of the Concession Agreement as well as with the applicable regulations from ICAO, DGCA, AAI and BCAS.

The master plan describes the strategic direction for development of NIA from the opening day, anticipated in FY 2024-25, to the end of the 40-year concession period.

Mr. Christoph Schnellmann, Chief Executive Officer, Yamuna International Airport Private Limited stated, «The approval of the master plan is a pivotal milestone, as it paves the way for the development of Noida International Airport for the next 40 years. The masterplan reflects the goals and objectives set, by providing solutions that are financially prudent, cost-effective, and commercially sound; at the heart of it remains passenger convenience. We are delighted that we have been able to complete the master planning activity within the agreed timelines, despite limitations due to Covid-19. We are looking forward to developing a world-class airport for the people of India that truly combines Indian hospitality with Swiss efficiency»

The first NIA masterplan sets the foundation for developing different avenues at various strategic locations across the airport site and thereby launching Noida International Airport as a destination in

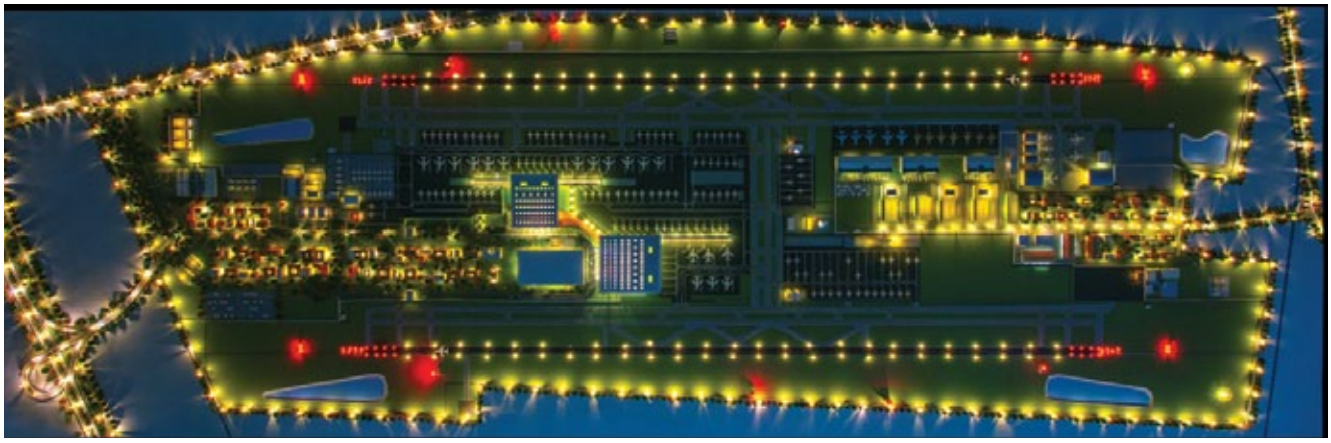
Phase	Phase I	Phase IV
Passenger Capacity	12 Million Passengers per year	70 Million Passengers per year
Air Traffic Movements	96,400 per year	489,700 per year
Cargo (Tonnage)	249,600	1,129,400
Cargo & Logistics (sqm)	79,700	407,000
Runways	North Runway 3900m	North & South Runway 3900m & 4150m respectively
Aircraft Stands	28 Stands	186 Stands
Passenger Terminal Building	Terminal T1 101,590 sqm	Terminals T1 and T2 Totally 488,000 sqm
Fuel Farm	3 x 3300 cu.m 37,000 sqm	8 x 6000 cu.m 56,000 sqm
General Aviation	100,400 sqm	180,700 sqm
Maintenance Repair & Overhaul	40 acres	
Real Estate Development	167 acres	

itself. It will be a confluence of air travel, high speed rail, metro, and road transport. Though the masterplan is prepared to accommodate the demand throughout the 40-year concession period with 2 runways, the Government of Uttar Pradesh has larger aspirations over the broader time horizon to ultimately have five runways. The airport masterplan provides the platform for this aspirational growth.

Once completed, the airport will house two passenger terminals. Terminal 1 will have a capacity of 30 million passengers per year and Terminal 2 a capacity of 40 million passengers per year. The terminals will be interconnected to facilitate the transfer for passengers, minimise walking distances and reduce environmental impact. Additionally, the modular development plan will minimise impact on operations during construction. The Inter-terminal connector is important to ensure flexibility for airlines and their operations.

The first Terminal (T1) will be built in two stages- the first for 12 million passengers per year, the second with an additional capacity for 18 million passengers per year. Terminal 2 will also be built in two stages - with a first stage capacity of 12 million passengers per year and second stage capacity of 18 million passengers per year. The forecourts for both terminals will have direct access to a single Ground Transportation Centre.

The NIA masterplan also has provision for general corporate aviation facilities, including a VVIP terminal, a general aviation terminal and heli taxi pads. These facilities will cater to the needs of state dignitaries, handle private jet movement and helicopters.



Exclusive

An Air Chief's Last Flight – And Why They Do It

Air Chief Marshal RKS Bhadauria flew his last sortie as Chief of Air Staff (CAS) on the morning of 13 September 2021. He was, as he had done many times during his tenure as Chief, flying a frontline fighter solo – in this case a MiG-21 Bison. The type of aircraft had more to do with history than familiarity or leading by example, although the latter is inevitable when any senior commander flies an operational jet, particularly one as controversial as the venerable MiG-21. This choice was about coming full circle – Bhadauria's flying career in the IAF began with MiG-21s of No. 23 Squadron 'Panthers' at Halwara, and so it ended, in a Panthers MiG-21 at the same station.

The Chief flew more or less like any line pilot would – a morning brief covering the flight profile, safety, weather, diversion airfields and so on, followed by a preflight check and climbing into the Bison. He took some time to re-familiarise himself with the cockpit before closing the canopy,

ACM Bhadauria just prior to taxi out for the last time in a fighter (photo: Angad Singh)

The CAS getting airborne from Halwara (photo: Angad Singh)

Air Chief interacting with the Panthers ground crew after completing his last fighter sortie (photo: Angad Singh)

The Air Chief with CO No. 23 Sqn after their flight (photo: Angad Singh)

starting up and taxiing out along with the CO of No. 23 Squadron. The sortie was short and uneventful, involving some close formation flying and aerobatics at height. When the jets returned to *terra firma,* Bhadauria's aircraft was welcomed in with a water cannon salute before he parked and switched off the R-25 turbojet for the last time.

Why do they do it?

The Indian Air Force demands that its commanders lead from the front – in times of war the first sorties are led by Squadron COs, as was the case in Kargil, Op Parakram, and the 2019 Balakot strikes. It is natural then, for senior leadership to imbibe and continue this practice even after they move on from active flying. The late Marshal of the Air Force Arjan Singh was famous for this as far back in the 1950s, when he was AOC Operational Command.

[Arjan Singh] was a typical 'operational' officer who believed in absolute professionalism. He was not impressed with the usual superficial spit-and-polish carried out in preparation for an inspection. All he expected was smartly turned out personnel who knew their job and carried it out efficiently. He did not like any fuss made over him and insisted that everyone went about their duties in their normal way. He visited our operational base without any warning, flying in by himself, in a single-seat fighter aircraft (Vampire Mk.52). His distinctive callsign was "One-Zero" and his radio call to our ATC was the first indication that he was just two minutes away.

[…] There was no ceremonial reception, no guard of honour, no fancy car, no silver tea service, no formal dinner, no unnecessary fuss. He did not bring a Staff Officer with him, or even an ADC. All he wanted was to personally check on the operational preparedness of the Station.

Those were the days, my friends! We knew we had a Boss who meant business. And we did our very best to never let him down. He nurtured our Air Force for the next 12 years, till he retired as the Chief of the Air Staff in July 1969. Later, after he was awarded the lifetime serving rank of Marshal of the Air Force on 26 January 2002, he continued to keep a benign watch on us.

These recollections, excerpted from a tribute penned by Air Marshal Shashi Ramdas on Arjan Singh's death in September 2017, are an evocative reminder

ACM Bhadauria with officers and airmen of No. 23 Sqn after his final flight (photo: Angad Singh)

of the value placed by the rank and file of a fighting service on leadership by example, and from the front.

The IAF is unique in the Indian military in that the service is almost entirely centered around flying and aircraft. Leaders who keep 'flying fit' and work toward getting stick time are not only better able to feel the pulse of the personnel and units they command, their being seen doing it reminds the force that their leadership is willing to put in the same effort and assume the same risks.

This has taken on greater salience in recent times, with Air Chiefs particularly keen to fly MiG-21s to dispel the aura of negativity surrounding the type (and similar legacy aircraft like the now-retired MiG-23 and MiG-27). The effect is of course amplified when the fighters are flown solo.

ACM Bhadauria flew the Rafale EH with No. 17 Sqn (photo: IAF)

The Air Chief before a Tejas LCA sortie (photo: IAF)

And if the CAS is qualified and able to fly a wider range of aircraft, he is able to 'reach' more of the men and women under his command, the transport and helicopter fleets being no less vital to air power than fast jets.

Air Chief Marshal Bhadauria has flown extensively through his 41-year career. When he took over as Chief in 2019, a press release put his hours at north of 4,250 across all types. He has added considerably to that total since putting on the fourth star. Although not the first chief to fly fighters, even solo, while in the top job, he is likely the Chief who has flown the most hours and most varied list of aircraft types – certainly in the modern era of complex and demanding flying machines.

Only the second test pilot ever to head the Indian Air Force (the other being ACM Srinivasapuram Krishnaswamy in 2001), Bhadauria is uniquely qualified to stay in touch with the machines his service operates. On taking over, he consciously elected to fly not just fighters like the SEPECAT Jaguar and HAL Tejas LCA he was so intimately familiar with, but a wider range of aircraft. Eschewing the idea of mere joyrides, he completed abridged conversion courses with dual checks on all aircraft he flew as Chief. He qualified on helicopters like the ALH and Mi-17 that often ferry military brass and dignitaries around the country, so he could fly them himself. Likewise, he converted onto the C-130J and VIP Embraer 135, getting stick time whenever he could.

Of course, he did fly fighters, with his Tejas sorties garnering the most attention over the past two years. He also flew the Bison solo on multiple occasions, as well as the upgraded Mirage 2000I, and even the IAF's prized new induction, the Rafale EH. In fact, he even put his testing qualifications to work on some occasions – when he flew Jaguars and Su-30MKIs, he specifically chose to fly recently modified aircraft so he could assess system-level changes firsthand. He has also flown prototypes of the indigenous Light Combat Helicopter and HTT-40 trainer with HAL test pilots. On a goodwill visit to Israel in 2021, he joined the Israeli Air Chief Major Gen Amikam Norkin for a sortie in an F-15D Eagle, adding to the list of over 40 different types of aircraft he has flown in his 41-year career.

ACM Bhadauria at the controls of a C-130J (photo: IAF)

ACM Bhadauria flew the LCH at HAL (photo: IAF)

The Chief after a sortie on a Jaguar DARIN-III variant. He commanded a Jaguar squadron, No. 5 Sqn 'Tuskers,' from May 1999 to July 2001 (photo: IAF)

ACM Bhadauria and Gen Norkin taxiing out for a sortie at an Israeli Air Force base (photo: Israeli Air Force)

Air Chief Marshal RKS Bhadauria flew his last sortie in a fighter aircraft as CAS on 13 September 2021. His flying career in the Indian Air Force began with No.23 Sqn, 'Panthers', flying the MiG-21 at Halwara, and so it ended, in the same aircraft of the same Squadron at the same Station! (Photo: IAF)

As ACM Bhadauria prepares to hang up his flying overalls for the last time at the end of this month, *Vayu* asked him about his 'hands-on' approach and the legacy he leaves behind. The Air Chief summarised his personal and professional motivations for *Vayu:* "Well, flying has been a passion for me and I have never let an opportunity go by for me to jump into the cockpit and get back in the air. Flying during my tenure as the Chief has been particularly rewarding, as it gave me the chance to stay in touch with the ground realities that influence the operational environment, both in terms of aircraft and bases across the IAF. It also enabled me to get a first-hand look at the capabilities and employability of our newly inducted platforms and systems."

The Vayu Team

Air Chief Marshal RKS Bhadauria, CAS, IAF and some highlights of his tenure

Throughout his illustrious military career, spanning almost four decades, the outgoing IAF chief held a number of significant field and staff appointments. To name a few, he headed a front line Jaguar fighter squadron and a premier Air Force Station in the South-Western sector, he was the Commanding Officer of Fight Test Squadron at ASTE (Aircraft and System Testing Establishment). He also served as the Deputy Chief of the Air Staff, Air Officer Commanding-in-Chief of the Southern Air Command and the Training command. The key highlights of his eminent career are:

The retired chief was an outstanding officer with exceptional flying skills. He has 4270 hours of flying experience on 27 types of fighters as well as transport aircraft. He flew over 900 hours as an Instructor, 400 hours as a test pilot and around 380 hours as Commanding Officer (CO). He holds the unique distinction of being an Experimental Test Pilot, a Category A qualified Flying Instructor and a Pilot Attack Instructor.

❖ As Deputy Chief of Air Staff, he played a critical role in the tough contract negotiations for the Rs 59,000 crore deal with France for 36 Rafale fighters.

❖ Out of 36 ordered aircraft, the IAF already had inducted 26 Rafales under his tenure as Chief of the Air Staff and successfully operationalised two indispensable fighter squadrons equipped with these combat-proven jets, No. 17 Golden Arrows at Ambala AFS and No. 101 Squadron at Hasimara Air Force station.

❖ The months-long stand-off between India and China in Eastern Ladakh was also a noteworthy event during Bhadauria's tenure as the CAS, and the operationalisation of Rafale squadrons was a massive boost to IAF's swift action near the Line of Actual Control. The IAF had also actively deployed its other frontline assets including Su-30MKIs, Mirage-2000s, AH-64Es, LCHs and Mig-29UPGs in key frontline bases near LAC as the situation remained inflammable.

❖ In the Indian military circle, he is best known for his strong backing for indigenous systems and capabilities. During his media addresses, he constantly talked about the need for acquiring niche technologies through the Indian industry to boost IAF's overall fighting strength. He emphasised the need for developing asymmetric capabilities indigenously to counter India's aggressive and technologically advanced neighbour China in the north.

The IAF at 89! From its first aircraft, the Westland Wapiti in 1932 to the two newly inducted squadrons of the Rafale, the IAF has come a long way. (Drawing by Amartya Mitra)

❖ His contribution to India's LCA programme is undoubtedly one of the most meritorious achievements of his entire IAF career. He flew the Light Combat Aircraft prototypes as a young test pilot and served as the Chief Test Pilot and Project Director of the National Flight Test Centre (NFTC) on the project.

❖ Fortunately, the Air Force ultimately finalised the long-awaited LCA contract with state-run Hindustan Aeronautics Limited for 83 enhanced LCA units dubbed as LCA Mk-1A under the supervision of CAS RKS Bhadauria early this year in February. The Rs 48,000 crore Tejas deal, the largest ever pact for an indigenous system for IAF, is perceived as a remarkable feat of his service as Chief of the Air Staff. The deal is a true 'Atma Nirbhar Bharat' transaction that would deliver a massive boost to India's defence ecosystem.

❖ Since 2019, ACM Bhadauria under his term provided substantial thrust to IAF's modernisation programmes including MRFA (new version of MMRCA 2.0), Netra Mk-II AEW&C, Mid-air Refueler Aircraft (MRA) and HTT-40 Basic Trainer Aircraft (BTA). Most importantly, IAF's Rs 5,000 crore Project Cheetah to upgrade and weaponise in-service Israeli-made Heron UAVs has now attained more prominence and is now at an advanced stage of implementation.

❖ The operationalisation of 'No. 222 Squadron (Tigersharks)' equipped with uniquely modified multi-role Su-30MKI jets at strategically located Thanjavur air base is another significant milestone for IAF under RKS Bhadauria. Tigersharks are equipped with Indo-Russian supersonic cruise missiles (BrahMos) to undertake extreme and specific maritime strike missions to support the Indian Navy in IOR.

❖ Over the past two years, the IAF has also taken part in various Humanitarian Assistance and Disaster Management (HADR) missions in the Indian Ocean Region. Today the massive strategic airlift capability of the IAF is a vital component of India's firmness in supporting HADR missions globally.

❖ The recently signed $2.5 billion deal for 56 C-295MW transport aircraft from the Tata-Airbus consortium for the Indian Air Force was another feature in his cap. Under this deal, 40 C-295's will be manufactured in India by Tata Advanced Systems Limited (TASL), the agreement will eventually make Tata the second Indian aerospace company to have an aircraft final assembly line (FAL).

Atul Kumar (Twitter @AtuL1617_)

Induction ceremony of Rafale into 101 Sqn at Hasimara

The Indian Air Force formally inducted Rafale aircraft into No. 101 Squadron at Air Force Station Hasimara in Eastern Air Command (EAC) on 28 July 2021. Air Chief Marshal RKS Bhadauria, Chief of the Air Staff presided over the induction ceremony. On arrival, CAS was received by Air Marshal Amit Dev, Air Officer Commanding-in-Chief, Eastern Air Command. The event also included a fly-past heralding the arrival of Rafale aircraft to Hasimara followed by a traditional water cannon salute.

Addressing the personnel during the induction ceremony, CAS said that the induction of Rafale had been carefully planned at Hasimara; keeping in mind the importance of strengthening IAF's capability in the Eastern Sector. Recalling the glorious history of 101 Squadron which bestowed upon them the title of 'Falcons of Chamb and Akhnoor', CAS urged the personnel to combine their zeal and commitment with the unmatched potential of the newly inducted platform. He said that he had no doubt that the Squadron would dominate whenever and wherever required and ensure that the adversary would always be intimidated by their sheer presence.

Chief of the Air Staff, Air Chief Marshal RKS Bhandauria, interacting with Rafale pilots of 101 Sqn at Air Force Station, Hasimara

101 Squadron is the second IAF Squadron to be equipped with Rafale aircraft. The Squadron was formed on 1 May 1949 at Palam and has operated Harvard, Spitfire, Vampire, Su-7 and MiG-21M aircraft in the past. The glorious history of this Squadron includes active participation in 1965 and 1971 Indo-Pak wars.

As of 29 July 2021, a total of 26 Rafale's have been accepted and ferried to India.

CAS along with the senior officers of EAC and officers of 101 Sqn during the induction ceremony

Water cannon salute to mark induction

Rafale flypast during the induction ceremony

IAF Rafale aircraft touching down at Air Force Station Hasimara during the induction ceremony on 28 July 21

Strength in diversity: The Sukhoi-Rafale Duo

IAF Sukhoi Su-30MKI

The Indian Air Force operates some world class equipment like the French built Dassault Rafale and the Russian made Su-30, however the reason of unique strength of Indian Air Force is because of fusion of such technological wonders. The Indian Air Force is currently receiving its brand new Dassault Rafales that are the most dominant aircraft of whole Indian-subcontinent, while the backbone of Indian Air Force, the Su-30 MKI's are no less with a quite long list of the achievements and records. The diversity in inventory of IAF is also a reason for creating logistical and geo-political problems, however on top of everything, it's one of the most important reasons why Indian Air Force have some unique mix of technologies like the C-17 Globemaster and IL-76 transport aircraft, Mi-35 and Apache attack helicopters and now Dassault Rafale and Sukhoi-30 MKI. The Sukhoi-Rafale duo is unique and can perform every role perfectly; currently these aircraft are the main workhorses of Indian Air Force and represents capability of the air force.

Brief introduction to both aircraft

The Sukhoi 30 MKI is a twin engine 4.5th generation heavyweight aircraft designated for air dominance role. The aircraft is extremely maneuverable because of its 2-D thrust vectoring control, canards and enormous maximum thrust of 246 KNs by its two AL-31FP engines. The Sukhoi 30 MKI is an excellent dogfighter because of its extreme maneuverability; further its pylons and mighty weight carrying capacity allow the aircraft to load diverse weapons and systems.

An IAF Sukhoi Su-30MKI can be seen here with a Brahmos underbelly

An IAF Flanker seen at Aero India 2019

maximum thrust of 150 KNs, the engines are extremely maintenance friendly and gives aircraft capability to super-cruise with additional payload. The Dassault Rafale has closed couple canards and a delta shaped body with high composite content that makes the aircraft extremely maneuverable because of its perfect thrust to weigh ratio.

Why Sukhoi-Rafale mix only?

As we can observe that both aircraft are extremely potent individually, however their capability increases by multiple folds after being operated alongside under a same air force. The Su-30MKI-Dassault Rafale mix is suitable for any operation, no matter whether it's Beyond Visual range (BVR) or Within Visual range (WVR) combat, whether its ability to launch long range standoff weapons or to conduct punitive raids like Balakot strike.

An IAF Rafale seen here in France before delivery

The Sukhoi-30 MKI has 12 weapon stations capable of loading Indian, Russian and Israeli weapons. The aircraft can be equipped with weapons like the Israeli Derby (planned), Russian R-73, R-77 and Indian Astra MK-1 in air-air role, with extremely accurate guided weapons like BrahMos supersonic cruise missile, DRDO SAAW, Spice 2000 and KAB-1500L bombs in air-surface role. The aircraft have enhanced electronic-warfare capabilities with advanced Israeli ELL 8222 and SAP-14/518 jamming pods with other French, Indian and Israeli sub-systems.

The N011M Bars radar of Su-30 MKI is also one of the world's most powerful radar with capability to detect objects from a large distance of 400 kms and track 15 objects simultaneously, the Sukhoi-30s are also known as mini-AWACS because of power of the Bars.

The Dassault Rafale is a French-origin twin engine medium weight 4.5 generation aircraft capable of performing all kinds of missions because of its "Omni-Role" characteristics. The Dassault Rafale is the most advanced aircraft in its category, it is a perfect aircraft for missions involving BVR warfare and deep punitive strikes.

The Dassault Rafale has 14 hard-points capable of loading a wide range of French weaponry and systems. The aircraft can carry various weapons like Paveway laser guided bombs, nuclear missiles, targeting pods with mainstay weapon being Hammer AASM guided weapons and Scalp missile in air- ground role with Mica missile and Meteor BVRAAM missile in air-air role. The electronic-warfare capability of Rafale is unquestionable with its SPECTRA EW suite that gives aircraft some next generation capabilities in EW. The aircraft is specially designed to reduce the cross-sectional area with features like small physical structure and high composite content, making it extremely difficult for any system to detect the aircraft.

The aircraft is powered by two Snecma M-88 engines that are capable of generating

What each mission would look like

Air to Surface role: The Air-Surface roles are mainly conducted either deep inside enemy territory or by launching long range standoff weapons without even entering enemy's airspace. While long range standoff weapons usually create more destruction, deep punitive strikes inside hostile territory have more long lasting physiological impact like Balakot strike. The Sukhoi-Rafale duo can perform any kind of air to surface role with excellence.

Punitive strikes: The Dassault Rafale is the most suitable aircraft for punitive

Rafale for the IAF preparing to take off from the Dassault Aviation Facility Merignac, France.

strikes. The aircraft can carry advanced air to surface weapons like the Safran Hammer which are known for their accuracy from their different mode of guidance like GPS, laser and IR guidance in different variants (range and warhead sizes). The Rafales, because of its low cross sectional area and electronic-warfare capabilities, are extremely hard to detect.

At the same time Su-30 MKIs master "the art of deception" which is a critical element for success of such strikes. The Sukhoi-30 MKI would make themselves visible to enemy radar and system, and would concentrate all the counter actions of enemy towards them, that in turn would make it extremely easier for real strike package to conduct strikes. It is a matter of fact that Sukhoi's performed such task even in Balakot strike to make mission much easier for real strike package of Mirage-2000s. The Su-30 MKI can carry similar air-ground weapons like Mirage-2000s but aren't designated for deep strikes and raids because of huge cross-sectional area and vulnerability to radars.

Long Range standoff weapons: Both Su-30 MKI's and Rafale can be equipped with long-range standoff weapons like BrahMos and Scalp missiles, both the weapons are world class and are far better than anything similar to them in their roles.

Scalp missile: The Scalp missile armed on the Rafale is a conventionally armed standoff missile with a maximum range of 560 kms and ability to carry a 450 kg warhead. The Scalp missile is guided initially with inertial navigation, GPS, terrain mapping and uses IR homing during terminal phase. The weapon is structurally stealthy, highly accurate and has extreme low flying ability with a speed of around 1000km/h. The Scalp has proven to be extremely efficient in multiple missions around the globe and was used as recently as Syrian Civil war where each Rafale was equipped with two Scalp missiles. The missile can be extremely efficient against enemy because of its high success rate, difficult interception and comparatively less price.

BrahMos–A: The BrahMos-A is the aerial variant of BrahMos missile equipped on Su-30MKIs. The BrahMos-A weighs around 2.5 tons with a range of approximately 500kms and ability to carry around 300 kgs of the warhead, further BrahMos is the world's fastest supersonic cruise missile with a speed of 3500+ km/h and an ability to skim as low as 10 meters that makes it nearly impossible to intercept missile. The BrahMos is of great significance to Indian Air Force, as a result IAF has deployed a whole squadron of BrahMos equipped Sukhoi's in Tamil Nadu for strong dominance in Indian Ocean region and conveyed a strong message by testing BrahMos off Sukhoi-30 MKI amidst Indo-China skirmish previous year.

Air to Air Combat: The Air to Air combat are majorly conducted in beyond visual range these days, however the within visual range combats also do happen. Unlike WVR combat, the BVR combat mainly depends on BVR missiles and the kill probability of a BVR missile depends on various factors like altitude and speed of enemy or launching aircraft, some BVR missiles like French Meteor and American AMRAAMs usually have higher kill probability than other counterparts.

BVR Combat: The Rafale is the most dominant fighter in BVR because of its features like modern AESA radar, EW capabilities and missiles like MICA ER and Meteor. The Meteor missiles are the main reason for advantage that Dassault Rafale holds in BVR combat, the missiles are often classified as 'World's best BVR missile' that are specially known for their unique ramjet propulsion and design to gives them a mighty range, extreme maneuverability and high kill probability even against strong electronic countermeasures.

The Sukhois on the other hand have powerful Bars radar that can also assist significantly in BVR combat by giving aircraft capabilities like early detection of enemy aerial assets and capability to track 15 objects at once. The aircraft is reportedly equipped and tested with several missiles like Astra MK-1, R-77, I-Derby and the rumoured K-100 AWACS killer missiles in medium-long range BVR combat. The aircraft also have vastly great EW capabilities because of its Israeli ELL-8222 and Russian SAP-14/518 jamming pods that also ensures the ability of aircraft to defend itself against enemy's BVR missiles.

However, the Sukhoi-30 MKIs had some problems in BVR combat capability

Trio of IAF Rafales

because of old variants of Russian R-77 missiles that had comparatively less range and inferior performance against modern countermeasures. The potential of BVR combat of Su-30 MKI has improved a lot than in the past, as now they are most likely to be equipped with better missiles like improved R77-1 and indigenous Astra MK-1, with plans to integrate the aircraft with missiles like Israeli Derby, indigenous Astra MK-2 and Astra MK-3 and even more advanced versions of Russian R-77 are also in list.

WVR Combat: The Rafale has closed couple canards and light composite built structure with 150 KNs of maximum thrust that makes the aircraft extremely agile and gives it a quiet good thrust to weigh ratio, the aircraft have some impressive features like maximum speed of 2222 km/h, GIAT M791 30mm auto-cannon and ability to super-cruise to ensure their endurance. The most important weapon of Rafale in WVR combat is MICA IR missile with an infrared homing seeker to improve kill probability in short-medium range, the MICA missile also has a TVC system to enhance missiles maneuverability and is capable of efficiently counter-countermeasures like chaffs and flares, the missile also provide infrared input to aircraft and works as an additional sensor with already existing Opto-electrical Infrared Search and track (IRST) sensor.

The Sukhoi's on the other hand despite being much heavier than Rafale are unbeatable in WVR combat and are often addressed as one of the 'most maneuverable' aircraft ever built because of their 'super-maneuverability'. The aircraft has some impressive features in WVR combat like canards, 2-D TVC system, mighty overall thrust of 246 KNs, max speed of 2,120 Kms/h, powerful GSH-30-1 30mm auto-cannon and large internal fuel reserves to bolster their endurance. The aircraft can carry R-73 IR homing missile (it is claimed to be the same missile with which IAF Mig-21 shot down a PAF F-16), along with different variants of R-27s also for WVR combat with a much powerful OLS laser-optical IRST scanner.

The Su-30MKIs were previously extensively upgraded from Su-30MK to MKI standards that had already solved numerous limitations, however they still have some problems regarding less operational availability, some old analog technologies and in BVR combat. The Su-30 MKI were questioned for having less operational availability of around 55% in many quarters previously, other problems include that they have a PESA radar against modern AESA radar that are lighter in weight, more effective with BVR missiles and are quite difficult to jam further regarding BVR combat, integration of new BVR missile have already sharpened the sword but still it seems a minor upgrade against capability of aircraft. Looking forward to all these constraints and enormous power of aircraft, the IAF is planning to upgrade whole fleet of 272 Sukhois to a 'Super Sukhoi' standard in future and equip them with more indigenous components like Uttam AESA radar and Astra missiles.

The Rafale is one of the most technologically superior aircraft currently, however as the technology around the globe is evolving rapidly it is also necessary to upgrade the aircraft in accordance to time. The Rafale will remain one of the most advanced aircraft for next few decades and ofcourse at some point get a mid-life upgrade.

Conclusion

The Sukhoi-Rafale mix is impenetrable and unmatchable in any kind of role as indicated many times by ACM RKS Bhaduria by statements like "Once the Su-30MKI and the Rafale start operating together, it will be a potent combination against our adversaries, be it Pakistan or anybody else. Any adversary would be worried about such a combination" and designated the combination as a "Game-Changer".

The Sukhoi-Rafale duo will be soon complimented with futuristic indigenous aircraft like AMCA and Tejas MK-2, which would ease excessive burden from these work-horses of IAF.

Pratisht Chaudhry

Solving the transport fleet fiasco of IAF

IAF C-17 Globemaster III seen taking off

The Cabinet Committee on Security led by Prime Minister Narendra Modi on 8 September 2021 cleared the proposal for procuring 56 Airbus C-295MW transport aircraft for the Indian Air Force. The long pending deal worth approximately USD 3 billion will replace the ageing IAF fleet of Avro HS-748 transport aircraft. In a major 'Make in India' step, the procurement will see 16 aircraft being delivered in flyaway condition from Spain within 48 months of signing of the contract while the remaining 40 aircraft will be manufactured in India by the Tata Consortium within 10 years of signing the contract. This will partially solve India's problem with its transport fleet.

The Indian Air Force is currently world's fourth largest. It operates various transport platforms as well. Along with the HS-748, it operates the Dornier-228, An-32, C-130J, Il-76 and C-17 as well. The transport fleet has a perfect blend of light, medium and heavy platforms to meet various requirements. But as India's strength grows, the need for far larger fleet and versatile systems grows as well. The best example in recent times to understand the importance of transport aircraft can be explored from recent Kabul crisis as aftermath of Taliban takeover of Afghanistan. As thousands of Afghans and foreign workers rushed to the Hamid Karzai International Airport to flee the Taliban, countries around the world sent their transport aircraft for quick evacuation. A US Air Force C-17A callsign 871 is reported to have evacuated 823 people in one go! Though it must be noted, for the evacuation special arrangements were done for utilisation of maximum interior space, still the sheer capability of the platform can't be denied.

HS-748 Avro will gradually be replaced by the C-295

IAF C-130J Hercules

BS Dhanoa at Aero India 2019. But both the Russian and Ukranian programme are going through some problems which will take a considerable time to be solved. In such conditions, C-295MW holds the best potential as a successful replacement to the An-32 fleet. The increased order will benefit local industries as a regional MRO (maintenance, repair and overhaul) facility for various variants of C-295 aircraft is going to be set up soon in India.

In the medium category, IAF operates just 12 C-130J Super Hercules. Though when Alenia Aerinautica proposed their C-27J Spartan against C-130, they had envisaged a market of 50 platforms in India. Clearly, the order for C-130 counterpart


IAF An-32

The Avro replacement will only partially solve India's problem with the transport fleet. The C-295MW is a modified version of the basic C-295. And with the enhanced payload capability with more than 9T, potentially it can be an ideal choice to replace India's aging An-32 fleet as well. India operates more than 100 An-32s and in past years has witnessed multiple unfortunate mishaps. In 2019, then the Chief of the Air Staff, Air Chief Marshall Birender Singh Dhanoa commented that the An-32 would continue to fly in mountainous region lacking imminent new alternatives. The Defence Minister, Mr. Rajnath Singh soon stated that 52 of the An-32 fleet had been upgraded (An-32RE). Though these upgraded fleet will continue to serve for a considerable time, the IAF has expedited the process to acquire newer platforms. Meanwhile, both Russia and Ukraine have offered their own products as a replacement of An-32. Russia is offering Il-112V against Ukraine's An-132D. Infact, An-132D conducted a demo flight in front of then CAS ACM hasn't reached up to that yet. But even with the limited number strength it has acted as an ideal tactical air lifter by supplying cargo in various geographical terrain as well as a key asset to humanitarian assistance. Recently, the IAF has renewed its contract with Lockheed Martin for another five years to provide dedicated and comprehensive support for the fleet.

In 2012, the Hindustan Aeronautics Ltd. (HAL) signed a contract with United Aircraft Corporation -Transport Aircraft (UAC-TA) of Russia for the development

IAF Dornier Do-228

for the Multirole Transport Aircraft (MTA). The ambitious plan for a 20T platform if successful would make India self reliant in this particular category. But the project got scrapped unfortunately and India is now struggling to find a feasible alternative. However, India has received offers from Brazil, Russia and Ukraine to fulfill the requirements. Infact, Embraer once offered KC-390 as a partner programme. The Russian offer of Il-276 and An-178-100R from Ukraine can be an ideal platform in 20T category. Meanwhile, Airbus is offering their A-400M Atlas with almost double payload capability. India's quest for 45 medium transport platform seems far from reality at this moment.

The IAF operates just 17 Il-76s and 11 C-17 Globemaster IIIs. The C-17 with a great 78T payload capacity can do all the jobs rest are incapable of. But Boeing ended the production of this behemoth back in 2015. And yet there is no plan from the manufacturer to restart the programme. Many experts believe, it was a faux pass from the IAF not placing additional orders of C-17. Ironically, IAF isn't the only one should be worried, rather USAF too reported exploring alternatives for future. In absence of C-17A, the only option currently exists is Il-76MD-90A which has considerably higher payload capacity than Il-76 currently in service with the

IAF Il-76 (photo: Joris van Boven)

IAF. In 2018, an Indian delegation from the Ministry of Defence was given detailed presentations on the Il-76MD-90A and Il-78MK-90A, the tanker variant. India definitely can understand the importance of such power lifters during the recent Afghan crisis where Indian Air Force assets were sent to the Afghanistan to evacuate Indian citizens as well as Afghan refugees.

China has already developed three indigenous transport platforms– light Y-8, medium Y-9 and heavier Y-20. Kawasaki of Japan manufactures the C-2 and recently South Korea too announced an indigenous transport aircraft programme. India not only lost a golden opportunity to enter the selective club in the field but is also struggling with the number strength. The Airbus C-295 through Make in India hopefully will bring a change which might be followed by other Make in India programmes as well. But for that the IAF must decide what it wants and should decide as fast as possible before it's late.

Sankalan Chattopadhyay
(Twitter @Vinoddx9)
(All photos Vayu except where mentioned)

Emergency Landing Facility for IAF in Rajasthan inaugurated

Raksha Mantri Mr. Rajnath Singh and Minister for Road Transport and Highways Mr. Nitin Gadkari jointly inaugurated Emergency Landing Facility (ELF) for the Indian Air Force (IAF) at Satta-Gandhav stretch on NH-925A near Barmer, Rajasthan on 9 September 2021. The two Ministers travelled to Barmer on a C-130J aircraft to inaugurate the facility. They also witnessed aircraft operations on the ELF, which has been constructed in just 19 months by GHV India Pvt. Ltd. under the supervision of IAF and National Highways Authority of India (NHAI). This is the first time that a National Highway has been used for emergency landing of aircraft of Indian Air Force. This landing strip will be able to facilitate landing of all types of IAF aircraft.

In his address, Mr. Rajnath Singh lauded the IAF, NHAI and the private sector for joining hands and completing the construction of Emergency Landing Field in 19 months despite Covid-19 restrictions. It is a great example of coordination among multiple departments and ministries; Government and private sector and Civil and Defence, he added. The Raksha Mantri defined the landing of IAF aircraft on the 3 km stretch as a historic new strength of New India, as it coincides with the 75th year of Independence and 50th year of India's victory in the 1971 war.

The Raksha Mantri described EFL near the International Border as a shining example of the Government's commitment to protect the unity and sovereignty of the nation. "This highway and landing field will further cement the basic infrastructure along the western border and strengthen national security. Such emergency fields will provide more edge to the operational and civil assistance of our forces. It will also play a crucial role in facing natural calamities," he said.

The NHAI has developed the three-kilometre section as an ELF for Indian Air Force. It is part of the newly-developed two-lane paved shoulder of Gagariya-Bakhasar and Satta-Gandhav Section having total length of 196.97 kilometres and costing Rs 765.52 crore under Bharatmala Pariyojana. The work commenced in July 2019 and was completed in January 2021. This project will improve connectivity between villages of Barmer & Jalore districts located on the international border. The stretch located in the western border area will facilitate the vigilance of the Indian Army and strengthen the basic infrastructure of the country. During normal time, the ELF will be used for smooth flow of road traffic.

Apart from the Emergency Landing Strip, three helipads have been constructed in Kundanpura, Singhania and Bakhasar villages under this project as per the requirements of the Armed Forces.

Minister of Jal Shakti Gajendra Singh Shekhawat, Chief of Defence Staff General Bipin Rawat, Chief of Air Staff Air Chief Marshal RKS Bhadauria, Secretary, Department of Defence R&D & Chairman, Defence Research and Development Organisation (DRDO) Dr G Satheesh Reddy and other senior central & state government officials were present during the inauguration of the Emergency Landing Facility.

The Giant Leap: Ajeet to Tejas

In October 1991, a decade before maiden flight of the first LCA prototype, Air Marshal Chandrakant V. Gole, former DCAS, responded to a request by then Defence Minister Sharad Pawar to brief him on the background, status, problem areas and options concerning the Light Combat Aircraft (LCA) project. 30 years later, this document is shared along with pertinent images to explain the situation as pertained to the time.

Four HAL Ajeets of No.2 Squadron (photo by Peter Steinmann)

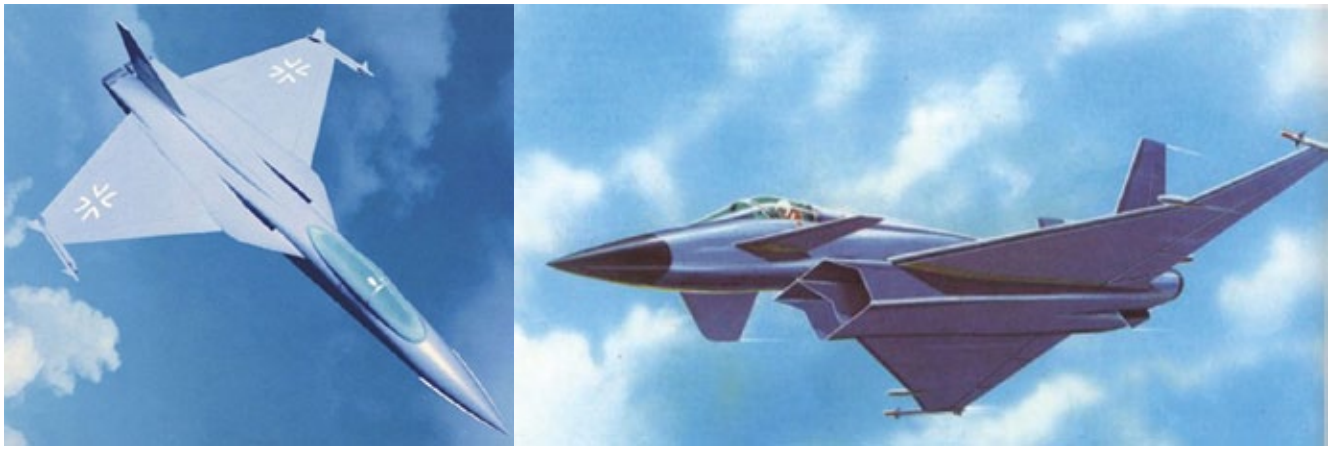
In 1975-76, the Light Combat Aircraft (LCA) was perceived as a replacement for the Gnat light fighter which was overdue for phasing-out, having served well for 15 years. An improved version of the Gnat, the Ajeet (*in photo above*) had not come upto the expectations and the fleet of Ajeets was due for progressive phasing out by the mid-eighties, proposed to be replaced by the LCA, six squadrons in all. A position paper prepared by Air HQ was discussed with HAL & R&D and a draft Air Staff Target (AST) was prepared by 1978-79. Over the next three years, however, the AST was uprated and what was envisaged as a light weight, low cost tactical aircraft requirement grew into a more sophisticated, high performance state-of-the-art aircraft.

This was partly owing to the additional requirement for a MiG-21 replacement and partly because of the trend or attraction of high technology. Whether the eventual LCA specifications were a result of purely operational considerations demanding such high technology or of the attraction of high technology spurring the hunger for "the latest and the best" (regardless of pragmatic operational necessities) is a moot point.

In 1982-83, a technical team of experts with Dr SR Valluri as the leader and the DCAS as the co-leader, visited well-known aircraft designers and manufacturers in Italy, Germany, France, UK and Sweden to explore possibilities of transfer of technology and joint collaborations. Italy was a total blank. The Germans had no requirements of their own, although MBB and Dornier showed willingness to take part in project, respectively based on their TKF-90 and ND-102 project definition studies.

The Air Forces of France, UK and Sweden had requirements for a new fighter in slightly more advanced class than the LCA. The French Rafale, British Experimental Aircraft Project (EAP), later to be known as the European Fighter Aircraft (EFA) and still later christened the Typhoon, as also the Swedish JAS 39 Gripen, emerged out of these requirements. However, a lighter, single-engined version of the British EAP/EFA, which had been studied by BAe (the P.106) seemed the closest to LCA requirements. A common feature of all these studies was the inevitable

Iconic photo of those who were charged with the LCA programme but were soon 'taken off' owing to extraneous reason, (left to right: Raj Mahindra, Dr Satish Dhawan, Dr SR Valluri)



The German companies Dornier and MBB had proposed futuristic designs to meet the LCA's air staff target and these were the ND 102 on the left and TKF 90 on the right.

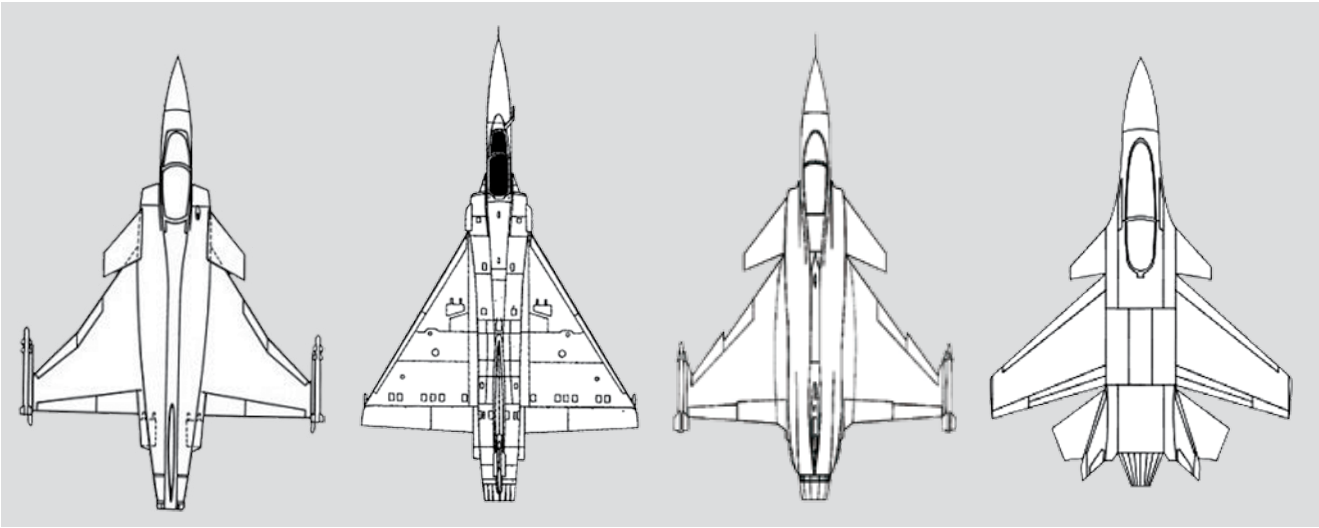
need for 'cutting-edge' technologies to meet the demanding performance.

In 1983, Design Bureaus of the erstwhile USSR, which had also been informally studying the LCA requirement, proposed a slightly heavier design, but one which fully met LCA specifications, and was based on conventional technologies. Their contention was that the conventional technologies, being within the capabilities of Indian designers, their design offered a better chance of success. So far, the main responsibility for studying and progressing the project was that of the aircraft manufacturer (HAL's Design Bureau), as is the practice the world over, with the Air Force monitoring and the R&D providing expert technical advice. In 1984, however, an independent, autonomous agency was created directly under the Secretary Defence R&D, named as the *Aircraft Development Agency* (ADA). It was to be responsible for evolving the design, while the actual engineering aspects of building/developing prototypes and later productionising it were left to HAL. Initially there was considerable resistance to this arrangement but the Atomic Agency and the Space Organisation were often quoted as examples, which was strictly not relevant since no industry existed in these spheres while in aeronautics, HAL was already a well established manufacturer.

Creation of the ADA took some time and in the intervening period of 2-3 years, the LCA specifications were further uprated, in keeping with the promised capabilities of the high technologies. The Air Staff Target (AST 201) was followed by the formal Air Staff Requirement (ASR) firmed in 1985. Having done some earlier studies with BAe and later with MBB of Germany, the focus then surprisingly shifted to Dassault of France, who provided technical assistance in preparing the Project Definition Report (PDR). The PDR was completed in 1987 and submitted to Air HQ, who after a detailed study, did not accept if fully.

Air HQ had serious reservations on

- The estimated timeframe which was considered too optimistic. As it was, the timeframe had been progressively advanced from the mid-80s, to early '90s, to mid-90s, and now to the next century (2001-03).
- The cost estimates were considered as far too optimistic.
- The capabilities existing in-country were not considered as adequate to absorb and fully indiginise the high technologies.



Various designs examined by the ADA team, some concepts, some reality; left to right BAe P.106B; Mirage 2000; Saab JAS-39 Gripen; Sukhoi Su-34

➲ The lack of competence, expertise and experience of our designers and engineers to undertake the project without any major foreign technical assistance/collaboration from renowned designers abroad. It was pointed out that thus far, not a single operational aircraft had been indigenously designed even with conventional technologies. Special critical areas were composite material technology for wings; fly-by-wire (FBW) technology demanded by an inherently unstable design; evolution of control laws and software for the FBW computer; the Multi-Mode radar; Mission Computer and integration of the multitude of state-of-the-art systems into an integrated; combat-efficient; fighter aircraft.

A committee was formed under Prof. Roddam Narasimha, then Director NAL, to consider various arguments of R&D and Air HQ. The solution suggested by the Committee became the basis of the present programme and envisaged:

Phase I: Design and Development of two full scale engineering development models (FSED or technology demonstrators) with core technologies, to be ready for limited flight-testing by 1995.

Phase II: Building of 5 full scale prototypes with all the systems and with the indigenous Kaveri (GTX) engine, to be ready by 1997 for full flight evolution upto initial operational clearance. This would be subject to the IAF accepting the project after evaluation of the FSED models (Phase I).

Production was expected to commence by 2001-2003. The total development cost was estimated at Rs.5000 crores of which Rs.1670 crores would be for Phase I itself.

The status in late 1991

Phase I of the programme has been on since 1989-90, a complex programme in view of several state-of-the-art technologies involved. Several R&D, production and academic agencies, such as HAL, NAL, DRDO laboratories, IITs, ISSC (Bangalore) etc., are participating in the programme. More than 80 work-centres have been identified and established. A point to note is that most of the work centres dealing with the critical areas are taking on sub-projects of such high technology levels for the first time. The risk/confidence level of a composite system like a combat aircraft is the sum total of the risk/confidence level of the sub-systems, but increases exponentially.

Prof Roddam Narasimha at centre with Prof Satish Dhawan and KR Narayanan, then Defence Minister and later President of India

The US connection – that was !

A year after Air Marshal Chandu Gole's briefing to Defence Minister Sharad Pawar, the latter held discussions with the US Defence Secretary Dick Cheney on various matters but, importantly, on possible US support on India's light combat aircraft (LCA) programme. Mr Cheney is understood to have assured his counterpart that the US would "encourage the LCA project and the Indian side was free to talk with US aircraft manufacturers to explore the possibilities of further development of the LCA".

Dr VS Arunachalam was Scientific Advisor to the Defence Minister when the LCA project was being sanctioned but went on to also become Director General of ADA, a Society formed to 'manage fund and monitor' the LCA which technically remains outside the DRDO domain

Accordingly, two officials from the Minister's delegation, Mr N Raghunathan, Secretary, Defence Production and Supply and Dr VS Arunachalam, Secretary, Defence Research and Development Organisation (and DG ADA), branched off to visit the Northrop Corporation in Los Angeles, as also the Rockwell Group. It is interesting that the ND-102 fighter project, subject of joint development between Northrop and Dornier had already been presented to the ADA team visiting Germany in 1984.

Dr Arunachalam, who was often referred to as the 'father of the LCA', once jocularly said that the initials were actually 'Last Chance for Arunachalam'. In the event, the only major US system (but the most critical at that) was the LCA's power plant, with the General Electric F.404 turbofan engine selected to power the LCA for which steady numbers were thereafter imported of the variant F.404 - IN 40 which presently powers the LCA Mk.1 and will continue to be the engine of choice for the LCA Mk.1A.

Post Script: Dr VS Arunachalam, taking time off from his post as Scientific Advisor to the Defence Minister/Secretary Defence R&D/ Director General ADA, took a sabbatical in the USA with the Carnegie Mellon University and also with Rockwell International, the major American manufacturing conglomerate involved in aircraft, the space industry, defence and commercial electronics.

Meanwhile, a number of costly facilities have been established or updated, including wind tunnels, composite material laboratories, advanced computers, structural testing, simulators and facilities for fatigue, systems proving, product qualification and so on. Preliminary work has already started at most of these work centres. Considerable work has been done on developing the necessary software capabilities, although a lot more needs to be done. The basic design of the aircraft has been finalised and frozen. Much work has been done on detailed design and drawings for some long-lead-time parts have been released. A sum of about Rs.380 crores has already been spent and this is expected to rise to Rs.500 crores in the very near future.

There is no doubt that work on Phase I is now well committed. Fair amount of confidence and enthusiasm has been built up and results of some of the preliminary work done are already visible e.g. the first generation flight simulator, development of software for CAD/CAM applications, airframe refinement after the wind tunnel and other studies etc. the time has now come - the first mile-stone so to say, to take a closer look at the progress made so far and assess whether the cost and time frame schedules indicated in the Narasimha formula are being adhered to and if not, to reassess the schedules and determine further course of action.

Presentations on various aspects of the programme were thereafter arranged at Bangalore for the Defence Minister and his Committee. The presentations were professional and to the point, and the work done so far, as reported, was impressive. However, what was perhaps missed was an assessment of what and how much remained to be done with reference to the time and cost schedules. The critical problem-areas were not dealt in detail and the resulting impression was that everything was running fine so far. However, reading between the lines, it was apparent that some problem areas had been identified or already encountered. A typical example was regarding the first three sets of composite-material wings which, it was stated, might have to be manufactured by HAL, which did not have the related technology, nor the facilities (e.g. autoclave) for the venture, The composite technology experience from the missiles programme and small components manufacture is not directly applicable to aircraft wings which are load bearing major components and call for much stringent specs and QA/QC requirements. Some of the problem/critical areas are given hereunder. These need a closer auditing by an independent team which should also assess their likely impact on the performance, cost and time-schedule of the programme.

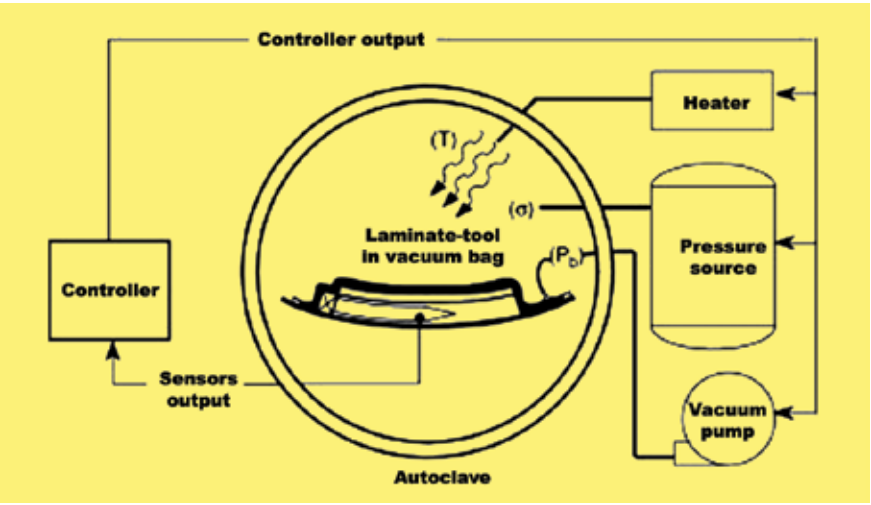
The time schedule

The most important factor from the point of Air Force or for that matter any military user, is the timely availability of a weapon system. Inordinate delays in the development and induction of a weapon system have a snow-balling effect. In addition to denial of the system to the forces, delays also disrupt users re-equipment plans and compel life extension (stretch) of obsolete systems, with expensive maintenance and provisioning problems. Costs also escalate because of normal inflation as well as prolonged overheads. Lastly there is a danger of the product be-coming out of date or obsolescent even before its induction.

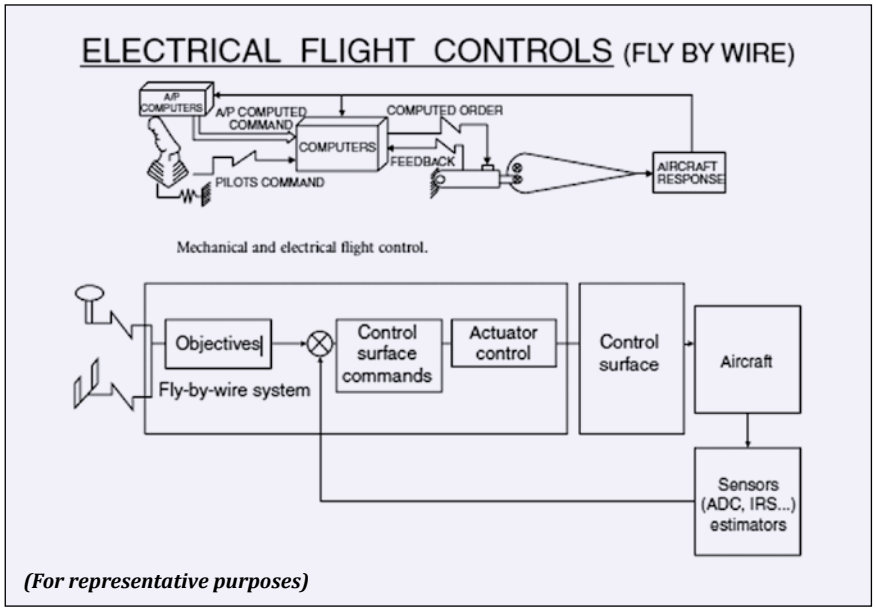
According to the present LCA schedule, the aircraft is expected to enter service by 2001-2002 or ten years from now and six years from the first flight of the FSED model. In the case of the French Rafale and the European Typhoon, the technology demonstrators were flown and demonstrated at the 1986 Farnborough Air Show. The final products are expected to enter service by 1995-96, or after ten years and this also with all the background experience, the vast infrastructure and the technological expertise available in these countries, In any weapon-system, making a prototype/demonstrator model is the preliminary step. There is a vast gap before a tested and proven, battle-worthy system can be delivered. In short, the LCA time schedule appears to be very optimistic, with no margin for technical glitches, organisational or decision delays, procurement holdups and other unforeseen problems.

The reality

Development cost of the Swedish JAS39 Gripen has been quoted at more than $3.0 billion, of the French Rafale at $ 6.0 billion, of the EFA Typhoon at $ 7.8billion, of the USAF's F-22 at well above $ 13billion. All these countries have well established facilities and expert manpower. We are still to establish a number of technologies and facilities. The development cost of the LCA has been projected at $ 2.0billion inclusive of the Kaveri engine and the radar. Our experience in R&D and licence production is inconclusive. Licence-manufactured aircraft invariably cost more than outright purchases. In R&D, on the other hand, the development costs of systems that have been developed so far, have mostly been less than the development costs of similar systems abroad, sometimes as little as 60%. The contributing factors are cheaper wages, starting with the scientists, engineers and managers down to the manual labour. Also the computation for the capital cost does not include the cost of establishing and maintaining expensive facilities/labs etc, with their own overheads. Even according to this costing method, the LCA development cost seems to be too optimistically low. The costing, therefore, needs to be scrutinised with great care. Manpower calculations



Manufacturing technique of composite structures (For representative purposes)



(For representative purposes)

other countries built up their experience on FBW system by stages, adopting a mix of digital and analog systems before going on to a fully digital system. We are going directly to a fully digital quadruplicate system, with an indigenously developed 32-bit Flight Control Computer. The Control Law's which dictate the flight computer's functioning/responses, is yet another risk area. The crash of the first Swedish JAS-39 prototype in its very early stage was attributed to deficiencies in the 'Control Laws'! We may need major consultancy/transfer of technology from experts abroad. Adequate latitude also needs to be made in the time schedule to allow for major debugging.

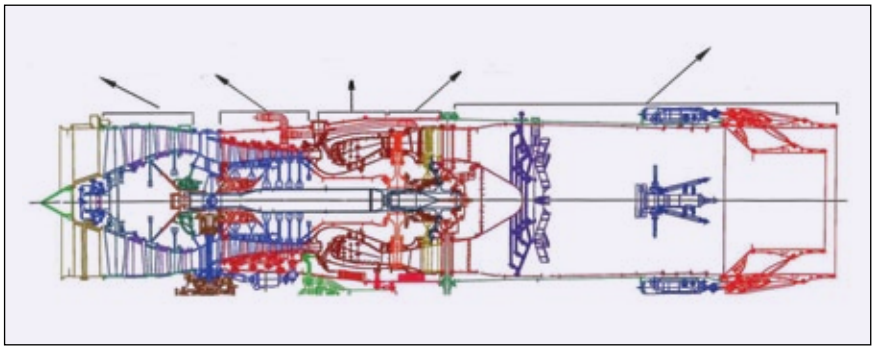
Work on the GTX engine (evolving into the Kaveri) started in the early 1970s. The engine being run at GTRE was one of the three prototypes built after a delay of over

also need examination. For instance 30 scientists are claimed to be working on the 'Control Law' for the FBW. BAe in UK, had to employ about 1000 for similar tasks for the EFA Typhoon.

Advanced technologies

The biggest risk factor is the advanced technologies proposed to be used in this project. In many of these, we have very little or elementary knowledge. Leave alone the main aircraft, even many of the sub-systems are extremely high-tech and in many of these areas, we have not designed even conventional subsystems. Even the basic production technologies will need radical changes and uprating. The only combat aircraft developed in India was the HF-24 Marut. This was, however, totally designed by Dr Kurt Tank and his German team. We were unable to develop an advanced version of the Marut or even of the Gnat.

We are now proposing to design, develop and manufacture a combat aircraft which will be equal to, if not better than any aircraft in that class in advanced countries. To aim for these goals is laudable. The technological gap has to be bridged. It is, however, a moot point whether the bridging can be done in one enormous leap. The old adage is you do not run before you have learnt to walk. These points are obvious and they must have been carefully weighed by the R&D. There is also no doubt that we have some of the finest brains but as Dr Vishweshwariah said "we have many excellent scientists but very few good engineers".



Schematic of the Kaveri engine (for representative purposes)

The major critical areas which have been identified so far are: *Composite materials* whose manufacturing technologies are different for different applications, depending on the requirements of structural strength, temperature, environmental condition, fatigue and so on. For the proposed composite material wings for the LCA, we will have to obtain the necessary technology, including production technology from firms abroad with the necessary expertise and experience.

Fly-by-wire controls and control laws are the very survival of any aircraft airborne which depends on reliable control systems, especially so for an advanced, unstable design. As a rule, before embarking on a new design with FBW, expertise and experience is built up on a 'hack' aircraft with conventional controls. Although at one stage a project was sanctioned for an experimental FBW system to be tried on a MiG-21, this never materialised. We are now embarking straight on an advanced, de-novo LCA design. Also on 7-8 years. No indigenous jet engine has yet been tested in the air, let alone being in service. As stated earlier, there is a vast difference between running a prototype on a test bench and an airworthy, reliable, bug-fee production model. The time and cost estimates for the Kaveri are unrealistic and we therefore should be prepared to make do with the standby US-origin F-404 or other suitable engine for quite sometime. This will mean accepting some shortfall in the aircraft performance.

The *Multimode radar (MMR)* is another ambitious project. Once again, even a conventional airborne fire control radar has not yet been indigenously produced. The LCA requirement dictates a cutting-edge technology radar comparable to those to be developed for the Typhoon and the Rafale.

The LCA's weaponisation must necessarily be built around this MMR, as delays or failure in its availability will make the LCA a lame duck. The users and

MiG-21s have been backbone of the IAF for near half a century (photo: Simon Watson)

the designers need to consider a fallback alternative (even if licence manufactured), with lower specifications but available today.

System Integration designing, developing and then integrating different new systems to make up a major composite system like a high performance, combat worthy, reliable aircraft, requires tremendous experience, expertise and practical skills. We should take lessons from the Jaguar DARIN project where we undertook to integrate just three avionic systems - with full support from the reputed manufacturers, and took over 8 years against an estimate of 3 years. Our aircraft design experience so far is limited to comparatively simpler and low performance aircraft like trainers and agricultural aircraft.

Development of an advanced aircraft does not only mean integration and manufacture of a prototype. It has to culminate into series production with the stringent requirements of QA/QC, reproduceability, exchangability, ruggedness and reliability. This calls for new production technologies, right from the inception. This is there-fore another important area where consultancy or technical collaboration from a major advanced-aircraft manufacturer will be essential. All the above point had been brought out by Air HQ in their comments on the LCA Project Definition Report.

The options for MiG-21 replacement

Precious time has elapsed over the last seven years. The LCA is now being offered nearly ten years later than the Air Force requirement of early '90s, By the early 21st century, virtually all MiG-21s will be due for phasing out and even the Jaguars will have been in service for over 20 years and the Mirages for 18. Certainly all the tactical/close air support aircraft will be overdue for replacement, involving some 12-15 squadrons. Non-availability of suitable replacements will have very serious effect on the operational capacity of the IAF. This must never be allowed to happen, especially after the lessons of the Gulf War which forcefully brought out the importance and vital necessity of superior air power.

Options available to us are limited. One is to terminate the LCA project and look for a suitable aircraft for outright purchase and licence manufacture. However, considering the volume of the requirement and the costs-trends, the cost will be enormous and unacceptable, even if there was no resource/Foreign Exchange crunch.

The second option is to carry on as at present and accept the possibility of serious depletion in the IAF's operational preparedness in case of further delays or short falls in the LCA programme. This option may not be acceptable from national security considerations.

The third option is to undertake a pragmatic appraisal of our capabilities and ascertain as to what can be done to increase the chances of success to a confidence level of at least 80 per cent. This would inevitably involve the injecting technology and major consultancy from abroad in the areas discussed above. The Foreign Exchange implications can be minimised by suitable reciprocal/buy back or credit arrangements. Some parties have shown such willingness.

Acceptance by the IAF of some short falls from the ASR especially in the requirements of the MMR, the engine, sustained/instantaneous turn rates, landing roll, etc. These can be given as concessions or a different ASR could be evolved for the LCA Mk.I. Work can, however, continue on the advanced version, say the LCA Mk.II, to meet the full ASR.

Otherwise, we must devise a solution to sustain the IAF's force levels in the interim period with a stretch potential to cover unforeseen delays in the availability of the LCA Mk.I. This can be done by updating and extending the life of the MiG-21 fleet, upgrading the Jaguar and MiG-27 fleet by additional production and acquisition of advanced jet trainers (AJT) which can also be used in close air support and home air defence roles as a stop gap. This would be is a subject for separate study.

The fourth option is to look for a willing country for a joint venture where both sides would share the work and cost. Co-production would not only ensure economy of larger production but also impose a lesser FE burden. Possibility of other customers could also then be examined. A number of third world countries are looking for MiG-21 replacements and this has great potential as nearly 3000 MiG-21s were produced and need to be replaced. This course of action will also ensure that the facilities and trained manpower generated so far are gainfully utilised. The only lacuna is the availability of a suitable partner who has similar requirements and who can offer the advantage of high technology and manufacturing experience. One possibility may be the USSR, however, the political environment in that country and the financial aspect may, however, make such an arrangement less attractive.

If we cannot find a suitable willing country for a joint venture, the fifth option is to look for a reputed aircraft manufacturer willing to participate in joint development, manufacture and marketing. The partner must be willing to share the cost and development work and use our facilities to the maximum. Massive aerospace groups such as Northrop, Deutsche Aerospace (incorporating MBB and Dornier), British Aerospace and others, could be approached. If a radical method is acceptable, the possibility of inducting a major, private industrial house in India in con-junction with the DRDO/HAL Design Bureau could also be considered.

Difficult decisions

Termination of the LCA project may mean a premature end to all aerospace advanced design & development activity in India. This is our last chance! Also, much time and money has already been spent on the project. A number of facilities have been or are being established. Much dedication and enthusiasm has been generated and it is in the national interest that all this must not be wasted. What is required is a practical and honest approach by all concerned.

Considering all above points, the fourth option (joint venture with a suitable friendly and willing country) appears to be most desirable. The only hitch is whether such a partner would be available. The next best would be the fifth option. Enquiries can be instituted to ascertain willingness of major aircraft manufacturers to enter into a joint venture. If ultimate or partial privatisation of aircraft industry is intended, then this is an opportune time to induct a willing civil

industrial house mainly to participate in aircraft or components production. Option three would be last resort.

Project Management – and the IAF

Except for the user representatives sitting in the two top committees, the IAF has had no participation in the present project management organisation. This is not in keeping with modern concepts nor is it conducive to elicit user's "commitment" to the project. In some advanced countries, where the Services manage their own budgets, such project management is headed by a full time senior service officer from the user. In our case, however, major changes may not be possible at this stage. What can be done easily, however, is the establishment of a permanent user's Project Team which will sit with ADA and whose leader should be appointed as co-chairman of the Programme Management Committee, In addition, either the Director of Air Staff Requirements or the user project team leader should be appointed as co-chairman of the Technical Committee, the Chairman being from ADA, as Chairman HAL has too much on his hands and is too senior a manager to co-chair the Technical Committee. Also as a matter of principle, there should be fewer Committees and more working teams.

A hard look at the future

There is no option now but to seek a suitable partner for joint collaboration while we continue work on LCA Phase I. An independent Review Team should be formed to work out the details and also take a hard look at the technology aspects as well as the time and cost schedules. These should then be revised as per the team's findings. The user should be fully involved in the process. The team's recommendations must be able to increase the user's confidence level in the project. An honest appraisal of own technological and engineering capabilities will be necessary. Simultaneously, the user should also be prepared to cooperate without reservations, i.e. show some commitment. Once the modified approach has been accepted, the user and the Government must commit fully to the project. There should be no further looking back since this hinders work and lowers morale.

If we are forced to go alone (option three) it must be appreciated that major consultancies and/or import of technology from abroad are necessary in the critical areas of composite material wings FBW and Control Laws, IOIR, and system integration.

According to the discussions with DG ADA, the project will require additional FE worth $ 370 million. (Rs 925 crore at 1991 exchange rate). Of this amount, $ 250 million (Rs.625 crore) is the absolute minimum, mainly for purchase of critical components, and for consultancies or the import of technology. If the LCA project has to succeed, then ways and means must be found to make this FE quantum available for the project giving the management a free hand in its utilisation.

The author, Air Marshal Chandrakant V Gole had a distinguished career in the Air Force, becoming Deputy Chief of the Air Staff in the critical years when the IAF was examining various options for new generation combat aircraft. He is seen here (at centre), visiting No.10 Squadron equipped with MiG-23BN swing-wing fighters. He later also headed the ASWAC programme

Fast Forward, 30 years to 2021

In the picture above are a pair of LCA Mk.1s (IOC) of No.45 Squadron IAF in formation flypast over AFS Yelahanka during Aero India 2021.

Over the 30 years since Air Marshal CV Gole's brief for then Defence Minister, much water has flowed down the Kaveri (pun intended) and following the first prototype's maiden flight in January 2001, there are some 40 LCAs built, flight tested, certified and delivered. Of these, two were technology demonstrators (TD), five prototypes (PV), eight limited series production (LSP aircraft) two naval prototypes (NP), sixteen initial operational clearance production aircraft (IOC), one final operational clearance (FOC) production aircraft, with another twenty three LCA Mk.1s still to be produced and delivered.

In a major boost to the overall programme, the Government approved production in January 2021 of 83 more LCAs (Mk.1A) for the IAF.

Ola Rignell of Saab India Technologies talks to us about....

Saab's Vision of Make in India-Building a world class defence and aerospace industry

The Indian Government's vision for Make in India is clear: Indian defence industry needs to become self-reliant or atmanirbhar, boost manufacturing and create new jobs in manufacturing. Defence and aerospace are meant to play a very important role in this process as drivers for innovation and technology injection. Recently, Defence Minister Rajnath Singh invited leading Swedish defence companies to set up manufacturing bases in India as he showcased India as an attractive destination for investment to produce military equipment and platforms. In an address at a virtual conference on India-Sweden defence industry cooperation on 8 June 2021, he said the government had initiated several reforms to help the defence industries to serve not only Indian requirements but also meet global demands.

Creating industrial supremacy

Saab´s commitment to the Indian Government's vision is firm: We want to be the Indian company that, in close cooperation with our industrial network, fulfils the ambition to establish India´s aerospace industry as a world leader. The world's biggest democracy deserves both Air Power supremacy - derived from the capability, availability and efficiency of its platforms – and also Industrial supremacy derived from the capability of its industry.

One could see Make in India as being about transferring old assembly lines from another country to India, and simply doing licenced production here, or we could look at what it will take for India's defence industry to truly become the center of the next technology revolution in defence and to produce the best-selling systems in the world. For that, Make in India should be much more than manufacture in India. We will have to look at Make in India as innovate, design, develop, prototype, source, build, test, redesign, manufacture, support and upgrade - in India, because Make in India will be successful only when it involves all these things. This is how Indian engineers will truly get the capabilities to create Indian systems that are the most technologically advanced in the world.

Write the manual, don't just follow it

One question that is often asked is whether Indian companies have the capability to absorb foreign technology. This question, again, assumes the old model of thinking – a model where the foreign OEM sends a blueprint and CKD kits, and the Indian company spends a few months understanding the blueprint and gets to work putting the kits together.

That's not how technology transfer should work. Technology transfer has to focus on capability development. A company making rivets for a fighter aircraft shouldn't be looking at a drawing and making a rivet. It should know why the rivet is that size, that shape, that weight. So it can go back and tell the tier 1 and OEM how to design a better rivet for the next generation aircraft.

And for certain, there are more companies in India, especially MSMEs, who are perfectly capable of writing the manual, not just following it.

True partnership – to share and cooperate

That's the partnership model that we work with wherever we go. We choose to have partners, not suppliers. We bring them to our facilities in Sweden, we show them how we work, we train them there on quality and processes, so that they can go back and train their colleagues. Because that's where capability is developed. That's how our partner companies gain, that's how we gain. That's how we're constantly improving and developing next-generation systems.

We might start with offering Swedish systems to India, but our long-term aim is to build Indo-Swedish systems that we can then offer to the world. That's our DNA. Our divisions outside of Sweden don't manufacture systems designed in Sweden. They create their own systems that they then sell to the world, including to Sweden.

Our South African division is making electronic warfare systems that are integrated on the Dhruv helicopter in India. When we work with Tech Mahindra at our R&D center in Hyderabad, we don't just handle IT support here. A large part of Gripen E programming and development work happens in Hyderabad.

Creating capabilities for sovereignty – and self-reliance

When we offer technology transfer on Gripen E, we talk about full technology and capability transfer. We aren't thinking of what documents to email and blueprints to courier to Indian companies. We're thinking about what centers of excellence to develop in India, which can support us in our activities around the world. Our plan includes university tie-ups and aerospace education. We're proposing to export Indian-made fighters to other countries.

When countries buy state of the art weapon systems, the question remains how much will the domestic industry benefit not in terms of current work on the project alone but build-up of capability. We will not only support a design, development, and a production facility but also offer in-country support. We will not only transfer all capability for building the Gripen fighter for the MRFA programme but also for developing different aspects of an aircraft that will support other indigenous programmes. Saab will hand over full capabilities to India which is not licensed production but is actually handing over of capabilities which was also stressed by our Swedish Prime Minister, should India and Sweden join hands in defence

We also plan to collaborate with India's research agencies and industry to develop the next generation of fighters. We're already thinking of being here for the next one hundred years and beyond, building aerospace capability that the world will use.

We look at Make in India as Create in India. We look at indigenous total aerospace capability development that will bring self-reliance and independence in aerospace manufacturing, not just assembly lines and licenced production that will inevitably perpetuate the cycle of dependency on foreign suppliers. We see both Sweden and India gaining from this.

That is what we call true transfer of technology.

Ola Rignell, Chairman & Managing Director, Saab India Technologies Pvt Ltd

VAYU Interview with

Surendra Ahuja,

Managing Director, Boeing Defence India

VAYU: How do you see the defence sector growing in India in 2021?

We remain confident in the long term growth of India's defence sector. The pandemic created some challenges in the short term, not just in India, but around the world. India has very important security and defence modernisation requirements and it has a dynamic ecosystem of growing companies and technical talent. I think our sector showed remarkable resilience and as we come out of the slowdown, defence modernisation imperatives will be driven with efficiency in capital budget utilisation and delivering more value by OEMs. Boeing is committed to delivering on its commitments and will continue to do so.

Today we are honoured to support India in its operations of 11 C-17s, 22 AH-64 Apaches (with six more on order), 15 CH-47 Chinooks and 10 P-8Is (with two more on order). We're engaged with our defence customers for the Indian Air Force's (IAF) Multi-Role Fighter Aircraft and the Indian Navy's Carrier-Borne Fighter programme. We are seeing the growth in the localisation of lifecycle MRO services along with it, with an emphasis of "for India, from India" via our investments in our Indian workforce and local partners, we support the Indian Air Force and Indian Navy to provide exceptional operational capability and readiness in support of their needs to protect the world's largest democracy.

VAYU: Boeing is also offering the F-15 EX in addition to Super Hornet for Indian Air Force's MRFA programme. What capabilities does the F-15 EX jets bring to the table?

In early 2021, Boeing received a marketing license approval from the US Government to offer the F-15EX to India. The F-15EX offers a future-ready, multi-role solution to the Indian Air Force that has superior deterrent and air supremacy capabilities relative to the competition.

The F-15EX is the latest and most advanced version of combat-proven, multi-role, all-weather day/night F-15 aircraft family. USAF recently signed an indefinite-delivery/indefinite-quantity contract with Boeing for 144 aircraft and the numbers could be even higher than 200. The $5B investment by USAF and international customers has made the iconic platform even more 'future-ready' by integrating leading edge technologies, networks, weapons and sensors to meet the adversaries of today and tomorrow. The F-15EX can carry large payload and offers unmatched performance in the form of range, speed and altitude. The F-15 is the only aircraft that has 104 kills to its name in air to air combat.

VAYU: What is the progress on the Apache programme? Do you anticipate more numbers?

The Indian Air Force today has 22 AH-64E Apache attack helicopters. Early last year, the Ministry of Defence signed the contract for the acquisition of an additional six Apaches for the Indian Army.

Our Tata Boeing Aerospace Ltd. joint venture in Hyderabad continues to be a critical source of Apache manufacturing not only for the Indian Army but for customers worldwide, including the US Army. The six Apaches for the Indian Army will be built at the state-of-the-art TBAL manufacturing facility right here in India. We continue to be committed to providing the most advanced capability to India's defence forces. We do believe that India has requirements for more Apache attack helicopters and we stand ready to support them.

airplane health management, environment-friendly coatings, advanced networks and secure-communications where teams leverage new-age technologies to replace traditional approaches, enhancing safety and productivity.

Boeing engineering design teams collaborate with our R&D team to leverage Artificial Intelligence and Machine Learning methods and in the process, resulting in a significant reduction in time taken for tasks, and also enhancing quality. Digital aviation efforts are also helping airlines reduce fuel consumption through route optimisation, and make effective utilisation of their crew. Digital engineering is being used to enhance the manufacturing environment and provide value to customers. Digital threading is being used to create a digital twin before manufacturing aircraft systems, resulting in fewer manufacturing issues. This drives efficiency, optimises product design, and enhances manufacturability, making the end-to-end supply chain more digital.

VAYU: Kindly elaborate on sustainment and training initiatives for the C-17 Globemaster III.

Boeing is working with the Indian Air Force to provide exceptional operational capability and readiness for the C-17s.

Boeing's Global C-17 support programme is a Performance-Based Logistics (PBL) contract designed to provide the United States Air Force (USAF) and international partners with maximum aircraft availability while optimising affordability, and lowest sustainment risks for all C-17 support elements

VAYU: What innovation is happening at Boeing India's engineering centre in terms of automation, intelligent equipment/platforms and man-machine interface?

Boeing's India Engineering & Technology Centre (BIETC) in Bengaluru and Chennai is leveraging a talented pool of employees in India towards innovation in aerospace. These engineers undertake high-quality, advanced aerospace work spanning engineering design of structures and systems, manufacturing support, developing systems to test our aircraft, and providing digital solutions to our airline customers. Cutting-edge R&D in traditional and emerging areas is also done at the Centre, including next-generation

The IAF's C-17 fleet is supported under the Globemaster Integrated Support Programme that maintains high mission capability rates by providing them access to an extensive support network for parts availability and economies of scale. Boeing provides onsite and multi-function support, with Boeing team members working closely with Indian Air Force operators and maintainers to ensure a high level of aircraft availability while reducing cost per flight hour. Boeing monitors obsolescence issues with a dedicated working group.

The proven, combat-tested, worldwide support for the C-17s include - 24 hour/7 day a week aircraft-on-ground parts response, Emergency in-flight technical assistance, Worldwide recovery support by Boeing and Access to worldwide inventories (spares, consumables).

Boeing also provides comprehensive C-17 Globemaster III training solutions for aircrews and loadmasters with advanced simulation, courseware and computer-based training. C-17 operators can practice the complete range of tasks required for tactical military airlift operations and humanitarian missions, along with mission rehearsal of other scenarios such as aerial refuelling and emergency procedures. Boeing's C-17 training centre in India has completed thousands of training hours for aircrews and loadmasters for the Indian Air Force.

VAYU : Lastly, can you provide an update on Boeing's sourcing from India?

Indian suppliers are an integral part of Boeing's strategy for growth, and are key to our commitment to strengthening India's aerospace industry. Boeing today works with more than 275 Indian suppliers and we have been steadily increasing our sourcing from India for its global manufacturing and supply chain. Boeing's sourcing from India is at approximately $1US billion today. In 2021, we are developing Micro, Small and Medium Enterprises (MSMEs) in support of our commitment to Aatmanirbhar Bharat. In fact, 26 percent of our suppliers from India are MSMEs.

Boeing's industrial partners in India are raising the bar to deliver world-class quality, cost-efficiency, and productivity as they become an important part of the company's worldwide supply chain for some of the most advanced airplanes in the world. Indian suppliers manufacture critical systems and components for some of Boeing's most advanced products such as the 777, 787 Dreamliner, 737, F/A-18 Super Hornet, F-15, CH-47 Chinook, P-8 and AH-64 Apache.

The Indian supplier landscape has also gone through a transformation over the last few years with proven capabilities in driving manufacturing predictability and performance. We have been consistently supported our partners in upgrading their capabilities and technologies through training, skilling and other initiatives. Our investments and partnerships are in a manner that best serves our customers and aligns to our strategy of shaping world class aerospace and defence manufacturing in India.

For example, Tata Boeing Aerospace Limited (TBAL), Boeing's first equity joint venture in India, with Tata Advanced Systems Limited (TASL) has been producing aero-structures for Boeing's AH-64 Apache helicopter, including fuselages, secondary structures, and vertical spar boxes for customers worldwide. Recently, Boeing also announced the addition of a new production line to manufacture complex vertical fin structures for the 737 family of airplanes. It demonstrates we are moving onwards in the journey towards Aatmanirbhar Bharat with Indian suppliers and in making the country a key hub for aerospace and defence manufacturing for the world.

Boeing's rise in India

Boeing P-8I of the Indian Navy

Boeing, a global designer and manufacturer of aircraft, spacecraft and weapon systems, has been actively advancing its business activities in the Indian subcontinent. With over 160,000 employees, the US multinational aerospace giant is the second-largest manufacturer of military airplanes and arms, it offers a wide range of airborne systems including missiles, fighter jets, attack helicopters, heavy military transport aircraft and helicopters to defence forces globally. With a diversified line-up of its cutting-edge systems, Boeing has been consistently speeding up the mission readiness and modernisation of the Indian Armed Forces in the 21st century.

After Russia, American defence corporations have now emerged as the leading weapon suppliers to the Indian military, and with more than $15 billion sales, Boeing is the largest US exporter of military hardware to India. Boeing continues its very long partnership with the Indian military, since the 1940s, supplying services, warplanes and weapon solutions. About 75 years ago, the fledgling Indian Air Force enrolled two Boeing warplanes, the T-6G Harvard advanced trainer and the C-47 Skytrain (Dakota DC-3) military transport aircraft, into its young fleet. Inducted in 1946, the second world war-era Dakota DC-3 (Parashuram in IAF) had played an indispensable role as the key airlift workhorse during the major post-independence conflicts including the 1965 and 1971 wars. This quintessential Boeing transporter had been the backbone of the IAF cargo fleet for forty long years. However, a refurbished version of Dakota DC-3 of IAF flew recently for the 1st time during Aero India at Yelahanka, Bengaluru.

Even today, Boeing plays a key role in the fleet modernisation of Indian armed forces. Leading cutting edge US military warplanes, such as C-17 Globemaster III, CH-47F Chinook, Poseidon P-8 long-range maritime reconnaissance aircraft (LRMRA) and AH-64E Apache Guardians have already been flying in the Indian colours. The company has supplied nearly tens of billions of dollars worth of military airplanes and hardware to Indian Air Force and the Navy in a single decade, from 2011 to 2020.

The eleven massive Boeing-supplied C-17 Globemaster III heavy-lift cargo planes are the much-needed boost to tactical and strategic airlift missions of the Indian Air Force. In 2011, New Delhi sealed a $4.7B pact with the US to acquire 10 Boeing-made C-17 airplanes, while Boeing delivered one more aircraft (which is the world's last Globemaster) under a separate contract signed in 2016. Deployed with No. 81 Sky Lords squadron, these giant Boeing's cargo planes are significant force multipliers for the country and are deployed extensively by the IAF for a wide range of military and emergency operations entailing troop transport, combat airlift, emergency humanitarian aid (food and medical supplies), and disaster relief. Similarly, the newly acquired fifteen tandem-rotor Boeing CH-47 Chinooks have also boosted the mission readiness of IAF's transport fleet. In the absence of IAF's Mi-26s fleet that is now grounded and needs a major overhaul to resume flying operations, the Air Force's 126 helicopter Flight (the Featherweights) squadron equipped with new CH-47 Chinook heavy-lift helicopters is actively taking part in all the crucial Indian military operations and disaster relief, they have been playing a major role in Ladakh amid border tensions with Chinese People's Liberation Army. Moreover, their deployment for life-saving operations in Uttarakhand during the recent 'Glacier Burst Disaster' was extremely significant.

Further, Boeing has also completed deliveries of 22 advanced-generation AH-64E Apache Guardians to IAF along with 15 Chinooks (I) under the same $3 billion contract sealed in 2015. Packed with unique Longbow MMW fire control radar, AIM-92 Stinger anti-air and AGM-114 Hellfire anti-surface munitions, these Boeing-made gunships are the most deadly attack helicopters globally. In absence of suitable options for high-altitude scouting and warfare, the Air Force has deployed some of its Guardian gunships fitted with Longbow FCR in Ladakh amid the deadlock situation

Boeing CH-47F Chinook of the IAF

at Line of Actual Control. In the meantime, the company is also executing a $900 million order of six Apache gunships for the Army Aviation Corps of the Indian Army.

Apart from the IAF and Indian Army, the American aerospace giant, also, has been upgrading the crucial ISR (Intelligence, Surveillance and Reconnaissance), ASuW and submarine hunting muscles of the Indian Navy by delivering the world's most advanced and proven multi-mission maritime warplane, the Poseidon P-8. The P-8I, an Indian variant of the USN's P-8A, has been precisely built and equipped with the systems preferred by the Indian Navy. Currently, the Navy operates eight of these naval force-multipliers which are being extensively used for a wide range of maritime missions and border surveillance due to its exceptional sensor capabilities. Four additional P-8Is are also being delivered to the Indian Navy worth $1.1 billion, while the Indian MoD has already approved a 3rd purchase contract for 6 additional P-8Is in 2019. As India and the United States have completed the troika of active defence cooperation agreements, the latest batch of these surveillance aircraft could bring a number of key advanced technologies and enhanced capabilities to the Indian Navy. These pacts, especially COMCASA and BECA, will enable Boeing's systems the real-time access to geospatial intelligence architecture of the US which eventually will boost ISR power and exactitude of the weapon systems fitted on P-8I. Moreover, these aircraft would feature encrypted communication systems from the US to form secure networks for exchanging critical intelligence and battlefield data between both militaries and likely with other Quad nations too.

Aside from supplying military airplanes, Boeing, also, is arming IAF as well as Indian Navy's aircraft with anti-ship weapons; multiple sets of Boeing-made AGM-84 Harpoon Block-II cruise missiles have been procured by the Navy, and these naval strike missiles are the mainstays on the Navy's P-8Is warplanes and Shishumar-Class boats. Similarly, the Air Force of India also acquired these subsonic anti-ship missiles for its Jaguar maritime strike squadron to expand its naval fighting capability. Interestingly, under the BECA (Basic Exchange and Cooperation Agreement) terms, these Harpoons too will get massive upgrade with high-quality real-time guidance to strike maritime targets with high precision.

Along with on-time deliveries of these military warplanes to the Indian military, Boeing, also, has been maintaining and providing a high serviceability rate since their induction. In this direction, it has already started exploring strategic Indian partners for the maintenance, repair and overhaul (MRO) of key military platforms under the newly launched Boeing India Repair Development and Sustainment (BIRDS) Hub. The Gurgaon-based Air Works is the first Indian collaborator under this freshly launched initiative.

To maintain its title of the largest US defence exporter to India, Boeing, now, is targeting the big-ticket multi-billion dollar 'Make-in-India' defence projects entailing the Air Force's MMRCA 2.0 contest for 114 medium-weight combat planes and 57 carrier-borne advanced multi-role fighters for the Indian Navy. Hence, Boeing has offered India both of its combat-proven fighter solutions; F/A-18 Super Hornet and the latest F-15EX. Interestingly, the F-15EX is the next-generation multi-mission iteration of the F-15 Eagle air superiority fighter, and being developed

for the United States Air Force, the aircraft completed its first flight recently. The airplane manufacturer has also secured the US government approval to pitch this under-development next-generation fighter solution to the Indian Air Force's contest for 114 combat airrcaft. Meanwhile, it has also tendered its latest Block-3 multirole variant of carrier-borne Super Hornet to India's Navy. And, to support Modi's vision of Atma Nirbhar Bharat, it is now proposing next-generation manufacturing plants and building techniques of these advanced US warplanes in India.

Furthermore, in a bid to influence its key Indian customer, Boeing also demonstrated carrier-borne Super Hornet 'ski-jump' from a ramp (a critical capability to operate from IN's STOBAR carriers), and as reports are emerging from various Indian media accounts, the Indian Navy is now considering a decisive plan to lease a 'Block-III' squadron of these Boeing-made navalised warplanes. At the Aero India exhibit, the company displayed all these advanced platforms including the KC-46A combat tanker that, also, has been tendered by Boeing to IAF's contest for 6 aerial refuelling aircraft.

In a bid to fulfil its commitment to developing an Indian supply chain, Boeing has formed multiple JVs and alliances with a handful of Indian aerospace firms, both public and private, to produce complex components and high-quality aerostructures of its modern-age military and commercial aeroplanes such as the 787 Dreamliner, 777X, 737, AH-64E Apache, F-15, F/A-18, Poseidon P-8 and Chinook. According to Boeing, the company has significantly expanded its sourcing from Indian vendors in the last few years. Presently, Boeing has quadrupled its sourcing over Rs 7,500-crore from India in the last two years.

With over 3,500 staff, Boeing's Indian arm, Boeing-India, has strengthened its presence across the country including New Delhi, Mumbai, Bengaluru, Rajali, Chennai and Hyderabad. Boeing's BIETC (Boeing India Engineering and Technology Centre) is also a significant case of the company's commitment to foster cutting edge aerospace and engineering innovations in India. In association with a network of academic and research institutions of India (12 R&D and 17 academic institutions partners such as IITs, IISc and CSIR labs), BIETC has been performing collaborative research and development in the areas of aerodynamic, aerostructures, advanced materials, manufacturing, communication networks and AI-enabled hardware and machine learning. Boeing Research & Technology-India has also delivered commercially viable solutions to AAI (Airport Authority of India) for Airplane Health Management (AHM) and Air Traffic Management (ATM). Overall, Boeing has now evolved as a true strategic partner of India.

Atul Kumar (Twitter @AtuL1617_)

Boeing AH-64E Apache of the IAF

IAF's C-17 Globemaster III

Pratt & Whitney: Powering Indian Air Force's Future

Since its foundation in 1925, Pratt & Whitney has been the world leader in designing, building, and servicing aircraft engines and auxiliary power units. Pratt & Whitney has been the engine power for aviation for India and the world – across regional, commercial, business, helicopter and military aviation,

In India, we have the largest footprint of any engine maker in the country, and one in every two people flying in India, fly on planes powered by Pratt & Whitney engines. We are continuously evolving our collaboration in-country – from our R&D centre at IISc Bengaluru that carries out research in the areas of advanced materials, gas turbine technologies, combustion and mechanical design; to our state-of-the art India Customer Training Centre in Hyderabad that has imparted 11,500 student days of training to over 39 operators representing over 27 nationalities so far.

Pratt & Whitney Military Engines: Performance and Dependability

Over 7,000 Pratt & Whitney military engines are in service with 34 armed forces worldwide. Pratt & Whitney's military engines portfolio includes the world's first operational fifth-generation engine, the F119 that powers the F-22 fighter, and the world's most advanced fighter engine F135 that powers the F-35. The F100 family power F-15s and F-16s, while the F117s power the mighty C-17 Globemasters. We also have the J52 for the EA-6B Prowler, the TF33 powering AWACS, Joint STARS, B-52, and KC-135 aircraft, as well as the PW4062 for the KC-46A Pegasus.

In India, our engines power critical platforms for the Indian Air Force (IAF). From the F117 engines that power the IAF's 11 Boeing C-17 Globemaster IIIs, and the PT6As that power its 75 Pilatus PC-7 trainers; to the recently approved C295 aircraft equipped with PW127G engines – we are proud to be the 'engine of choice' for IAF's modernisation.

PW127G on the C295: Versatility, Efficiency and Dependability

The Indian Government recently approved the procurement of 56 C-295 military transport aircraft for the IAF. With 40 of the 56 aircraft being manufactured in India, this is a significant step towards India's self-reliance. The C295 is powered by Pratt & Whitney's twin PW127G engines that enable the versatility and efficiency of the C295. The PW127G is part of Pratt & Whitney's PW100/PW150 engine family which powers a variety of aircraft platforms flying diverse missions including regional commercial airlines, firefighting, aerial surveillance, cargo transport, humanitarian work and civil defense. With their low fuel burn during cruise, these engines give the C295 exceptional range and endurance for time-critical missions. Pratt & Whitney is proud to be the engine on the C295 programme, and this marks the start of another great chapter in our partnership with the Indian Air Force.

The F100-PW-299 for the F-15EX: Engine of Choice for India

The F100 engine has been entrusted by the US Air Force to power every F-15 in its operational fleet since the aircraft's first flight in 1972. The F100 is an industry leader in fighter engine reliability, providing excellent value to its operators through low costs per flight hour.

The engine's fully modular architecture ensures ease of maintenance and incorporates leading edge technologies in materials, cooling, and health management including some advanced 5th generation technology. The latest upgraded F100-PW-229 is also fully capable of integrating with the F-15EX's fly-by-wire flight control system.

The F100-PW-229 is technologically fully capable of powering the most challenging missions against any adversary – now and in the future. Therefore, as India selects its 114 fighters for the MRFA, the F100-PW-229 is the 'engine of choice' to power India's F-15EX.

Pratt & Whitney looks forward to being the engine power behind IAF's modernisation. We have already been an integral propulsion partner for India's indigenous aircraft programmes such as the NAL-SARAS (MKI) with our PT6A engine, and our APUs power India's Netra Airborne Early Warning and Control System (AEW&CS).

Ashmita Sethi, President and Country Head, Pratt & Whitney, India

VAYU Interview with William L. Blair,

Vice President and Chief Executive, Lockheed Martin India

VAYU : What are the air to air capabilities that the F-21 would provide to the IAF? How do you see these capabilities complement those of the existing IAF fleet?

The F-21 fighter aircraft is on offer to the Indian Air Force and Lockheed Martin is leveraging both 4th and 5th generation technologies to offer the best solution to meet or exceed the IAF's capability needs, provide Make in India industrial opportunities, and accelerate India-US cooperation on advanced technologies, including but not limited to fighter aircraft.

This aircraft, which will be manufactured by Lockheed Martin, the world's largest and most advanced defence manufacturer, is the most advanced 4th generation fighter we have ever offered. The F-21 would serve as a force multiplier for the Indian Air Force with an unmatched capability-to-cost ratio compared to the competition. In addition, the F-21 is equipped with state-of-the-art systems and sensors that would allow the Indian Air Force to detect, track and engage

multiple targets in a contested environment. The current and future state of warfare is and will be around gathering and sharing information across multiple domains (air, space, land, sea, and cyber) to make effective wargaming decisions as quickly as possible. The F-21 will be able to integrate across these domains and across Indian services to provide current and future relevance. Furthermore, it will have the growth capacity to integrate indigenous systems in the future as and when the battlespace changes in order to meet future Indian Air Force (IAF) requirements.

F-21 is equipped with Triple Missile Launcher Adapters (TMLAs) which allows for a max Air-to-Air weapons loadout of 10 missiles. This, along with the F-21s superior range/loiter time and 5th gen AESA radar, allows for maximum staying power with the ability to execute first look, first shot, first kill in modern and future warfare environments.

This aircraft is the perfect complement to both the Rafale and the Tejas in terms of operational performance. It also provides the IAF with a single engine, low Life Cycle Cost platform at a Max Take-Off Weight (MTOW) right in between both of these formidable aircraft.

Our F-21 offering demonstrates Lockheed Martin's commitment in delivering an advanced, scalable single-engine fighter to the IAF — For India, From India.

VAYU: What are the 'Make in India' industrial opportunities associated with Lockheed Martin's F-21 offering for India?

The industrial opportunities associated with F-21 will put India at the epicentre of the world's largest fighter production and sustainment market worth $165 billion not only supporting the Make in India programme of the government but also other key initiatives such as Skill India, Startup India and Atmanirbhar Bharat.

The F-21 offering includes sourcing advanced systems and components from across India via our unrivaled track record of developing robust industrial ecosystems across the globe. This programme will generate tens of thousands of employment opportunities through the maturation of India's large and emerging aerospace and defence (A&D) manufacturing ecosystems, including Defence Public Sector Undertakings; Micro, Small & Medium Enterprises; private; academia and research and development.

We see great potential and future for India in ramping up and emerging as a regional hub for MRO for planes and helicopters. Our successful joint ventures in Hyderabad established over a decade ago — Tata Lockheed Martin Aerostructures Limited (TLMAL) and Tata Sikorsky Aerospace Limited (TSAL) have been instrumental in helping India achieve its goal of developing an aerospace and defence supplier ecosystem, promote indigenous manufacturing and participating in the global supply chain. Our JVs and Indian partners have generated $600 million worth of exports and produced over $200 million in India industry revenues. As evidenced by these JVs, we have a robust in-country infrastructure to promote indigenous manufacturing, participation in the global supply chain and collaboration on other projects including but not limited to fighter aircraft.

VAYU: What kind of infrastructure has Lockheed Martin created for present and future programmes in India?

India is an important market for Lockheed Martin, and we have an established defence and aerospace footprint in the country that spans more than three decades. The cornerstone of our strategy rests on building and nurturing partnerships with the Indian industry, with whom we share technology and capability and co-produce and co-develop for India and from India.

As shared earlier, our successful joint ventures in Hyderabad established over a decade ago — Tata Lockheed Martin Aerostructures Limited (TLMAL) and Tata Sikorsky Aerospace Limited (TSAL) are a testament to Lockheed Martin's partnership with India and Indian industry.

The TLMAL facility manufactures major aerostructure components for the C-130J Super Hercules transport aircraft. This is the sole supplier of these components to Lockheed Martin and is an integral part of our global supply chain. To date, TLMAL has manufactured 150 C-130J empennages. It also manufactures other aerostructure components like the centre wing box and recently, work has also begun to create a first of its kind autoclave capability for composites. TLMAL also employs 500+ skilled team members and has been recognised globally for its job training programmes, including the Diversity & Inclusion programme.

The TSAL facility manufactures aerospace components for commercial helicopters and aircraft and has expanded to include aircraft engine components for aerospace industry companies as well. As of now, TSAL has delivered 157 S-92 cabins to date.

Nearly 240 suppliers feed into these two joint ventures and have benefited from the vision of Lockheed Martin and Tata working together. $600 million worth of exports have been generated by our JVs as well as the Indian suppliers that we have engaged with on greater global supply chain opportunities. Through our JVs in India, we have contributed about $100 million of manufacturing equipment tooling IP etc. Currently we have integrated more than 70 Indian suppliers into our global supply chain.

We continue to build upon our more than three decades of partnership with India, expand collaborations with local industry to support the growth of indigenous defence manufacturing ecosystem under 'Atmanirbhar Bharat', and further advance India's strategic security and industrial capabilities.

The C-130J at Aero India 2021

TLMAL delivers 150th C-130J Super Hercules empennage

Tata Lockheed Martin Aerostructures Limited (TLMAL) recently delivered the 150th C-130J Super Hercules empennage from its manufacturing facility located in Adibatla, Hyderabad. The delivery milestone highlights the ongoing success of Lockheed Martin's hallmark 'Make in India' partnership with Tata Advanced Systems Limited (TASL) established more than a decade ago.

TLMAL, a joint venture between TASL and Lockheed Martin Aeronautics, was established in 2010 in alignment with the Indian Air Force's acquisition of its first six C-130J 30 Super Hercules airlifters. TLMAL exemplifies the Make in India goals and has the distinction of being the single global source of C-130J empennage assemblies that are installed on all new Super Hercules aircraft produced in Marietta, Georgia, in the United States.

Empennage assemblies produced by TLMAL include the aircraft's horizontal and vertical stabilizers along with leading edges and tip assemblies. The TLMAL team also previously manufactured sets of C-130J center wing box components and introduced a cutting-edge 4,700 square-meter metal-to-metal bonding facility in May 2018. TLMAL currently employs close to 700 people.

In April 2018, TLMAL increased the indigenisation of C-130 manufacturing by transitioning the production of approximately 2,200 (of 2,500+) previously imported empennage components to Tata Sikorsky Aerospace Limited (TSAL), Lockheed Martin's second joint venture with TASL. These components were previously manufactured by suppliers located outside of India. Currently, every empennage that is delivered around the world is built in Hyderabad and its components will be further indigenised from 85% to up to more than 95% by Q1 2022.

Commenting at this milestone occasion, Mr. Sukaran Singh, Managing Director and Chief Executive Officer, Tata Advanced Systems Limited, stated, "The TASL–Lockheed Martin partnership is a true demonstration of collaborated workmanship in aerospace and defence manufacturing in India". He further added, "The manufacturing and operational excellence achieved by the team through this decade-long partnership, has led India to become the only supplier of C-130J Super Hercules empennage, globally. I congratulate the team for this achievement and enriching partnership."

TLMAL empennages are included in C-130Js that support critical worldwide search and rescue, peacekeeping, combat delivery, maritime patrol, special operations, aerial refueling, medevac and humanitarian response missions. TLMAL empennages are also included in the LM-100J — the commercial variant of the Super Hercules.

"Many people, thousands of hours and massive amounts of commitment helped the TLMAL team reach this milestone," stated Kiran Dambala, Chief Operating Officer at TLMAL. "Fueled by a strong partnership between Tata and Lockheed Martin, the TLMAL team puts its pride and energy into meeting and exceeding customer expectations with each and every C-130J empennage delivered. While C-130Js are flown by a multitude of operators around the world, each empennage is a product of India and reflects the 'Make in India' initiative. Our team has accomplished so much with these first 150 empennages and is ready to achieve even more with the next 150 empennages."

The C-130J Super Hercules is the proven standard in tactical airlift, providing a unique mix of versatility and performance to complete any mission, anytime, anywhere. It is the current variant of the C-130 Hercules and is the 'airlifter of choice' for 26 operators in 22 nations. The Indian Air Force operates a fleet of 12 C-130J-30s, exemplifying the airlifter's versatility by landing it on the highest landing strip in the world — Daulat Beg Oldi in northern India — to relying on the C-130 for regional military, peacekeeping, medevac, humanitarian relief and natural disaster support missions.

(Both photos: Vayu)

MBDA: Celebrating Indian Air Force Day during a landmark year

Indian Air Force Day 2021 comes at a special time when the partnership between MBDA and the IAF has just gotten even deeper with India having received the majority of its new Rafale fighter aircraft.

With Rafale now in the IAF's inventory, the IAF can also field a new and potent suite of weapons from MBDA. Unquestionably the most famous is the Meteor, the ramjet powered and network-enabled beyond visual range air-to-air missile that is widely recognised as a game changer for air combat. Meteor's throttleable ramjet engine provides sustained high-supersonic power, making it the only missile able to chase down manoeuvring enemies at even the longest of ranges.

No less game-changing for the IAF is the SCALP stealthy air-launched cruise missile that also forms part of the Rafale weapons package. This potent weapon will give the IAF an unrivalled and flexible tool to conduct deep strike missions at long ranges against even the most protected of hostile targets.

Another MBDA weapon, MICA provides both the Rafale and the newly upgraded IAF Mirage 2000 aircraft with a uniquely flexible approach to air combat. MICA is the only missile in the world featuring two interoperable seekers (active radar and imaging infrared) makes MICA highly countermeasure resistant and therefore highly effective.

With a strong reputation as a reliable partner that has supported the Indian Air Force for over 50 years, European missile firm MBDA understands the importance of operational capability and sovereignty to the IAF. For these reasons, the company has so strongly committed to 'Make in India' to deliver both industrial sovereignty and the best of military equipment to India.

Indian firms now supply key components for key new missiles that are enhancing the combat power of the IAF. For example by Indian industry today to extensive manufacturing of 15 major subassemblies of MICA missile covering various complex technologies such as mechanical, electrical, electromechanical and pyrotechnic items. MBDA continues to deepen its relationship with Indian industry, as seen by the recent formation of a joint venture with long-standing partner Larsen & Toubro to deliver a series of important missile programmes under the 'Make in India' category.

The IAF is also getting a major boost with the addition of the ASRAAM as its Next Generation Close Combat Missile. During 2021, MBDA and BDL agreed to establish a new facility in Hyderabad to assemble and test this potent air combat missile. With its large rocket motor and clean aerodynamic design, ASRAAM has unrivalled speed and resultant aerodynamic manoeuvrability and range. ASRAAM gives it a high kinematic capability that delivers superior end-game performance for within visual range air combat. MBDA's ASRAAM missiles are significantly enhancing the battle capability India's Jaguar bombers, giving them unrivalled self-protection ability and enhanced ability to penetrate hostile airspace. This highly capable weapon could also boost the combat capability of other IAF aircraft.

Working with HAL, integration of the Mistral ATAM system on the Dhruv helicopter and the Light Combat Helicopter (LCH) has been successfully completed. Key to many of MBDA's offerings are their ability to be fitted to multiple platforms. By utilising the same weapon across different platforms, not only do extra aircraft benefit from these capabilities, but there are also major cost savings and operational benefits to be found in maintaining common equipment stockpiles, not to mention the training and logistics benefits. For example, utilisation of the Mistral missile on India's helicopter platforms provides a bridge to their use in a ground based VSHORAD role, where the missile is fully compliant with India's requirements and outperforms the capabilities of its rivals.

Boris Solomiac, MBDA General Delegate India

Lockheed Martin in contract to IAF's C-130J Super Hercules

Lockheed Martin has been awarded a $328.8 million, five-year contract from the Indian Air Force (IAF), to provide dedicated and comprehensive support for the IAF's fleet of 12 C-130J-30 Super Hercules aircraft. Lockheed Martin is the original equipment manufacturer (OEM) of the C-130Js, which is the tactical 'airlifter of choice' for 26 operators in 22 nations.

Through this Follow On Support II (FOS) contract, Lockheed Martin teams manage the programme, logistics and engineering support elements necessary to sustain the IAF's C-130J fleet. The contract spans a five-year-period, is a Direct Commercial Sale, and is a continuation of a prior five-year FOS I contract where Lockheed Martin provided similar support for the IAF's C-130J fleet.

"As the C-130 OEM, Lockheed Martin brings forth an outstanding team of experts who offer deep knowledge and unmatched insights of the C-130 to our operators," stated Rod McLean, Vice President and General Manager, Air Mobility & Maritime Missions, Lockheed Martin. "It is an honour to continue to partner with the Indian Air Force to support one of the most active C-130J fleets in the world.

support fleet

Through an integrated team and dedicated support, Lockheed Martin ensures the IAF's C-130J fleet is available and ready for every mission."

The FOS II contract includes Lockheed Martin's sustainment efforts for the IAF's entire Super Hercules fleet, as well as extended options including Lockheed Martin support for the C-130J airframe, Contractor Furnished Equipment (CFE), peculiar and common spareable items, engines, propellers, software, publication services, ground handling equipment (GHE), ground support equipment (GSE) and test equipment.

A total of eight employees representing Lockheed Martin, GE (propeller manufacturer) and Rolls-Royce (engine manufacturer) serve as on-site technical support for the duration of the contract. Additionally through the FOS II contract, five C-130J Hercules aircraft will undergo 12-year servicing (depot maintenance) at a Lockheed Martin-approved Heavy Maintenance Center (HMC) beginning in 2022.

The Government of India announced its purchase of six C-130J Super Hercules airlifters via a Foreign Military Sale with the US Air Force in 2008. All aircraft were delivered on or ahead of schedule between 2010 and 2011. India received additional C-130Js in 2017 and in 2019.

The IAF's C-130J Super Hercules have a highly integrated and sophisticated configuration primarily designed to support India's special operations requirement. The aircraft also are equipped with air-to-air receiver refueling capability for extended range operations. India's C-130Js are also used to support a variety of critical missions, including humanitarian aid, airlift, natural disaster support, and search and rescue operations. Recently, the IAF has been extensively using its fleet of 12 Super Hercules for humanitarian efforts in the wake of the Covid-19 pandemic as well as for transportation of relief materials, equipment and personnel in the areas affected by cyclones Yaas and Tauktae.

India's connection to the C-130J goes beyond its fleet of Super Hercules with the Tata Lockheed Martin Aerostructures Limited (TLMAL) joint venture that is the single, global source of C-130J empennage assemblies included on all new Super Hercules aircraft. Located in Hyderabad, TLMAL exemplifies the Government of India's "Make in India" objectives and has delivered more than 120 empennages over its first 10 years of operations.

Rod McLean, Vice President and General Manager, Air Mobility & Maritime Missions, Lockheed Martin

BDL and MBDA to establish ASRAAM facility

An IAF Jaguar seen with two overwing mounted ASRAAMs at Aero India 2021

Bharat Dynamics Limited (BDL) and MBDA are establishing a facility for the Final Assembly, Integration and Test (FAIT) of Advanced Short Range Air-to-Air Missile (ASRAAM) in India. BDL and MBDA signed a licencing agreement to establish the manufacturing facility in India and an agreement was signed by NP Diwakar, Director (Technical), from BDL and Mr. George Kyriakides, International Industrial Cooperation Director from MBDA in the presence of Commodore Siddharth Mishra (Retd), CMD, BDL at a virtual ceremony.

Under the licensing agreement, MBDA will transfer the equipment and knowledge to BDL for establishing the facility. Work on establishing this capability in India is due to start immediately and is expected to commence operations by the year 2022-23.

Commodore Siddharth Mishra (Retd), CMD, BDL stated, "that signing of the licencing agreement reinforces the Company›s commitment to contribute towards 'Make in India› and the ‹Atmanirbhar' initiatives of Government of India in the defence sector. ASRAAM is one of the Within Visual Range missiles available and BDL will be manufacturing these at its Bhanur Unit for the domestic and export in future through MBDA. The new facility will provide India with the ability to carry out final assembly, integration and test of ASRAAM missiles. BDL has been endeavouring to enter into tie-up with foreign OEMs (Original Equipment Manufacturers) in pursuit of its expansion programme. The agreement signed with MBDA, is one such effort, which will go a long way in further strengthening the collaboration, which BDL has with MBDA for its various missile programmes".

Mr. George Kyriakides, International Industrial Cooperation Director of MBDA stated, "We are very pleased to be establishing this new ASRAAM facility in India with BDL. MBDA has a long and highly successful history of working with BDL for over four decades, a partnership that has seen BDL manufacture large number of MBDA-designed Milan missiles in India."

The agreement to establish the facility follows on from an earlier Memorandum of Understanding (MoU) between BDL and MBDA on ASRAAM FAIT signed during 2019. This new BDL ASRAAM facility will have the potential to also conduct maintenance, repair and overhaul (MRO) of ASRAAM missiles. The facility can also be adapted to conduct final assembly, integration and test of the CAMM missile of MBDA. CAMM is the missile used by the Sea Ceptor naval air defence system that has been offered as Short-Range Surface to Air Missile (SRSAM) requirement.

"ASRAAM, a Within Visual Range Air Dominance weapon, is New Generation Close Combat Missile. Its low drag, aerodynamic airframe, unrivalled speed and manoeuvrability throughout its flight, increased agility make the best missile in its category of weapons. The missile has full 'Lock On Before Launch' and 'Lock On After Launch' operating modes" stated company officials.

Thales in India: Building a trustworthy and secure tomorrow

Ashish Saraf, VP & Country Director - India, Thales

Research and innovation are now at the economic centre of India's growth story. There have been collective efforts from the government, armed forces, industries, and academia to stimulate the advancement of technological innovation in the country. The government's allocation of Rs. 500 crore to push research and innovation in aerospace and defence by supporting 300 start-ups is one of the latest examples of these efforts. As rightly said by Shri Rajnath Singh, the honourable Defence Minister, India can become an economic superpower if it achieves advancement in enabling technology.

Keeping innovation at the helm of its operations, Thales has been a steadfast partner of India for close to seven decades now. Through a diverse mix of high-technology solutions, services and collaborations, the organisation has brought its global expertise in defence, digital identity and security, aerospace, space, and transportation to India. With 1,800 employees working with Thales and its joint ventures in India, the organisation is looking to strengthen its presence in the country and has plans to hire at least 300 more this year for high technology roles.

'Aatmanirbhar Bharat Abhiyaan': an opportunity for growth

The vision of Aatmanirbhar Bharat has marked a series of initiatives which aim to achieve more indigenisation and self-reliance in India. The progressive steps to provide priority to indigenously designed and developed defence products mark a shift towards self-reliance in true essence of building an "Aatmanirbhar Bharat".

Thales, standing together with India at every step of the way

Thales has contributed in providing teeth to Rafale's game-changing weapons through a range of solutions such as the AESA RBE2 radar, the SPECTRA electronic warfare suite for 360° detection and action modes, advanced man-machine interface with displays in cockpit, missile electronics, the front-sector optronic with infrared search and track systems FSO-IRST, the CNI suite (communication, navigation, identification) as well as power generation systems and a logistics support component.

Thales is also proud of the upgradation of the Mirage 2000 fleet of the Indian Air Force. Apart from this, the company also offers a host of systems for India's armed forces ranging from night vision devices and carbines to unguided rockets for attack helicopters.

Nurturing local industrial and supplier partnerships to support India's defence and aerospace needs, Thales has more than 50 offset partners and more than 75 supply chain partners. Exemplifying the spirit of "Make in India", Thales has also formed joint ventures in India - formed a JV with Reliance Aerostructures in 2017 and with Bharat Electronics Ltd. (BEL) in 2014, among others. Through these JVs, Thales has built comprehensive skillsets in India to contribute towards sustainable manufacturing in India for India as well as in India for the world focused on exports.

The future is digital and unmanned systems

With the future seen belonging to digital technologies, UAV and CUAV solutions, Thales identified the trends early and invested more than 7 billion euros globally in technologies such as connectivity, big data, artificial intelligence, cybersecurity and quantum computing amongst others. Research and Development (R&D) and innovation are crucial to Thales for its success. Discovering new ways to step up to the challenges of modern society, Thales brings to the table a unique combination of technologies and talent that make Thales a key player in keeping the public safe and secure, guarding vital infrastructure and protecting the national security interests of countries around the globe and in India. Progressing in this direction, Thales' Engineering Competence Centres (ECC) in the National Capital Region and Bengaluru have been fostering R&D, and serving its projects and customers in India and abroad across different markets.

As an expert in civil/military aerospace with over 40 years of experience, we develop and implement integrated end-to-end solutions to command, control and coordinate air operations and to ensure flight safety, sovereignty and air superiority. Thales' solutions provide safety and security at all levels of the airspace both military and civil.

We make UAVs across the Group for the civilian and military markets (Spy'Ranger/ Watchkeeper/UAS 100 etc.). We provide unmanned traffic management (UTM) derived from our expertise in air traffic management (ATM) and also counter unmanned aerial vehicles (CUAV) measures derived from our Air Defence expertise and enhanced by partnerships with small companies.

Thales, can manage the entire drone ecosystem — UAV systems, UTM, surveillance, C-UAS, neutralisation to assist with the alignment of players/lead this ecosystem of civil and military organisations, regulatory bodies, major defence and aerospace companies as well as the many agile and innovative SMEs in the segment.

Thales provides solutions allowing civil and military aviation authorities to detect - even without data transmission - and verify a drone's registration number, identify its pilot, and confirm its flight authorisation, all in a few seconds. By the same time, to cope with unexpected or non-registered drones, detection and classification are the first steps before engaging a graduated response.

Thales will continue to help its customers master their decisive moments in an increasingly complex world. The organisation remains committed to India and helping its customers prepare for tomorrow, today. Thales congratulates the Indian Air Force and fellow Indians on the account of the 89th Indian Air Force Day.

Media tour to Russia - Part II

(cont'd from Issue 4 Jul/Aug 2021)

Almaz-Antey factory visit

Every once in a while, the world comes across a weapon system that wields a disproportionate amount of strategic and political influence. From HMS Dreadnought to the Shah of Iran and his F-14's this article chooses to concentrate on a slightly more 'up to date' example, the S-400 Triumf.

What is the S-400?

The S-400 is the most dangerous, operationally deployed, modern long-range Surface to Air Missile (SAM) system in the world. With a maximum effective range of up to 400km (215 nautical miles), the system can reportedly track up to 100 airborne targets and engage six of them simultaneously. Additionally the S-400 reportedly has the capability to counter low-observable aircraft and precision-guided munitions, all while being retaining flexibility and remaining extremely mobile. The S-400 system, whilst commonly thought of as a single missile-toting truck, is a multi-element system comprising two batteries, each with a command-and-control system, one surveillance radar, one engagement radar, and four TEL (Transporter-erector-launcher) trucks.

S-400 Transporter-Erector-Launcher truck being deployed at Almaz-Antey NWRC

The S-400 operates in the following way:

1. The Long-range surveillance radar tracks object and relays information to command vehicle for target assessment.
2. After the target is identified, a missile launch is ordered by the command vehicle.
3. The launch vehicle which is placed in the best position gets the launch data and releases the missile.
4. The missile is then guided toward the target with the help of the engagement radar.

This Russian system serves as an excellent example of an anti-access/area-denial (A2/AD) system. The idea of A2/AD is to prevent an opposing force from entering an area and limit an opposing force's freedom of action in said operational area. Customer deployments of the S-400 reveal that such systems tend to offer broad strategic effects, while not the first SAM to threaten aircraft hundreds of miles away (the SA-5, deployed since 1966, has a range of 150 nautical miles) the S-400's capabilities render it far more dangerous than a traditional defence-oriented SAM system. With an ability to engage a wide range of targets, including stealth aircraft and cruise missiles, its range against aircraft operating at medium or high altitudes can threaten aircraft in neighbouring countries within their own air space. This capability alone raises the risk of operating expensive aircraft anywhere near a deployed S-400 system. Costing the tax payer a few million dollars, a single missile from an S-400 battery could potentially bring down an opposing asset worth hundreds of millions of dollars, doing so from farther away than any adversary SAM has yet been capable of. The S-400 thus offers a favourable cost ratio that could potentially influence decision-making at strategic levels.

The S-400 system will enable Indian forces to deter or influence the behaviour of aircraft and the application of airpower in peacetime. Russia's deployment in Syria has already illustrated this possibility.

While Russia showed no intention of using S-400 batteries to engage US or coalition aircraft (except perhaps those belonging to Turkey), air operations planners in the theatre would have likely developed new procedures to guide manned and unmanned aircraft flying within range of the S-400. If Russia chose to do so, it could have effectively neutralised the effectiveness of US, French or NATO aviation based in the Mediterranean. A subsequent coalition turn to standoff munitions significantly increased the per-shot cost, possibly dissuading more vulnerable allies from participating in the US led high-end conflict.

Why am I writing about it?

Vayu Aerospace and Defence Review was invited to be among India's first few organisations to tour the production facility at Almaz-Antey's North West production centre and be briefed on the S-400 system. As per the Mikhail Podvyaznikov, Director General of the North West Regional Centre, deliveries of the five regiments of the S-400 Triumf are to begin on schedule as per contract. At the time of writing Indian Air Force personnel are already in Russia, to undergo instruction and train on this brand new system.

As the saying goes, seeing is believing. In order to not just see us off laden with brochures and statistics, North West Regional Centre (NWRC) were keen to show us their sprawling facility, its modern casting and treatment facilities, state of the art test centre and beautifully curated museum.

Take my word as an aerospace engineer that the production of Strategic Ballistic Missile Defence Systems requires extremely rigid quality control and high quality production facilities, sub-orbital physics takes no prisoners! On the territory of NWRC is a galvanic-chemical coating workshop and foundry capable of manufacturing up to 500 tonnes of liquid metal a year. As relatively new production facilities, incorporating an open architecture approach to manufacturing and a high degree of automation, all of these facilities excel in producing not only military, but also dual-use and civilian products.

The casting process

One of the key highlights of this visit was a demonstration of the S-400 Triumf test centre. With a site for climate testing of large-sized products, replicating a wide range of conditions, temperatures from -70 to +100 degrees Celsius are reproduced in special shielded rooms. The site is also equipped with a sprinkler chamber, particularly important for a customer that sits square in the middle of the annual monsoon's path. A single 'TEL' truck was pre-soaked ahead of our visit and promptly driven out and deployed all in just enough time for Vayu to scramble into position to take pictures. With dust chambers, thermo-pressure chambers and a whole array of mechanical testing facilities (centrifuge, shock resistance, vibration, etc.) the author is left in no doubt that Russian weapon systems continue to uphold the Soviet standard for ruggedness.

S-400 Triumf sprinkler chamber

Our tour ended with us ogling at the NWRC museum, from forging Imperial Russian Naval guns to building and driving T-34 tanks straight out of the factory gates and onto the front lines (barely tens of kilometres away at the height of Nazi power) Almaz-Antey has been at the forefront of their nation's defence from well before Indian Independence. With exhibits detailing their extensive experience in the field of air defence (a trio of SA-2 'Goa' missiles greet you at the entrance), high-precision machine work (Optical lens manufacturing machinery) and just brute force scale of manufacturing (models of countless artillery pieces and tanks) what struck me as rather poignant, one of their key exhibits is a piece of Gary Power's U-2 spy plane, brought down by a missile from this very facility.

Model of the factory as it was in 1916

Article and photos: Angad J. Maolankar

Severnoye Design Bureau:
75 Years and going strong!

Pr.17 Shivalik class frigate

Another view of the Pr.17 Shivalik class frigate

The manufacturer of Talwar-class frigates, Russian Severnoye Design Bureau (SDB), was established in USSR in 1946 for designing destroyers and patrol ships. In the course of time, the scope of tasks has expanded significantly. The company has developed almost the entire ocean-going surface fleet of the Soviet Union of which many projects became true milestones.

The development of a modern ship involves work and intellectual activities of many teams and thousands of specialists in various industries. However, it is the Severnoye Design Bureau that plays the key role as an integrator. Over 75 years of work, 550 ships and vessels were built to SDB designs. The company is credited with the world's first ships equipped with anti-ship missiles and the first large warships where gas turbines were used as part of the propulsion system. The Bureau developed anti-submarine ships and destroyers featuring 'exceptional' seaworthiness, also ships described as 'aircraft carrier killers' and heavy nuclear-powered missile cruisers, the pride of the Russian Navy.

Pr.15 Delhi class

CEO Severnoye Design Bureau Andrey Diachkov: "Proposal to the Indian Navy on upgrades to the first batch of Talwar-class frigates"

CEO Severnoye Design Bureau Andrey Diachkov

Severnoye Design Bureau has submitted a comprehensive proposal to the Indian Navy on upgrades to the first batch of the Talwar-class frigates that have been in service with the Indian Navy since 2003-2004.

CEO Severnoye Design Bureau Andrey Diachkov told *Vayu* the following: "Our company has elaborated the proposal to make a complex upgradation that ensures maximum efficiency of all weapon systems of the ships. Rosoboronexport forwarded the proposal to the Indian Navy Headquarters. We highly respect the Make in India policy, our experience of work with the Indian partners has proved its effectiveness, taking into account that Make in India programme has been developing in leaps and bounds. We are ready to work with an Indian shipyard that would be assigned by the Indian Navy. We are ready to implement the modernisation according to the requirements of the Indian Navy. We are proud to underline that Talwar-class ships have earned a high esteem for the service period with the Indian Navy".

"Sea-surface ship is a complex structure with a long service life. In order to ensure ships' service life and combat capabilities all the leading fleets of the world provide the possibility of upgrading the main equipment of the ship by replacing a number of systems with modern ones with updated performance characteristics. Replacing the weapon systems arranged onboard with the newer and more up-to-date ones enables the ships to perform their battle missions in an appropriate manner yielding to no other ships of a later construction. This procedure will extend the combat capabilities of the ships as well as simplify its operation and maintenance along with the new ships", further stated Andrey Diachkov.

Pr.16A Brahmaputra class frigate


Pr.11356

Since 1998, SDB has been developing projects using an automated three-dimensional numerical modeling system. In 2015, the company enabled to exchange project data via a secured channel between the Bureau and a shipyard.

Presently, SDB continues to support construction of Pr.22350 frigates for the Russian Navy. These ships are featuring completely new capabilities. Multipurpose Pr. 22350 frigate is equipped with state-of-the-art integrated systems and weapons, which enable to provide high accuracy managing of a wide task scope. These ships are able to reinforce surface action groups significantly. The leading Pr.22350 frigate named Admiral Gorshkov was delivered to the Russian Navy in 2018, while the second vessel Admiral Kasatonov entered the Navy in 2020. The third frigate Admiral Golovko became the first ship of this programme to be equipped with a propulsion plant of Russian origin. Now six frigates are under construction at the Northern shipyard in St.Petersburg.

In 2019, Admiral Gorshkov together with Russian Northern Fleet ships and support vessels made a round-the-world voyage, that achievement was marked in the Russian Armed Forces' Book of Records. In 2020 the frigate successfully fired a new Zircon hypersonic cruise missile.

SDB has also established Pr. 22160 offshore patrol vessels being under construction for the Russian Navy at Zelenodolsk Shipyard. This is the first Russian ship designed using a modular weapon concept. Part of the armament is to be mounted at the construction stage and is not changed throughout the entire service life. The remaining reserved areas and spaces can be used to accommodate additional weapons during repairs or upgrades. In addition, there are special places for accommodating various removable modules, which can be replaced during operation, depending on missions at hand. To date, three ships of this series have already joined the Russian Navy, and three more are in various stages of construction.

SDB is also proud to present its Pr.22460 Rubin-class border guard ships that have been under construction since 2007. Thirteen ships have already been commissioned by the Border Guard Service of the Russian Federation and another one is undergoing trials. The armament of the border ships consists of one 30 mm six-barreled AK-306 automatic gun and two 12.7 mm Kord machine guns. Rubin-class ships can be operated both in equatorial waters and in thin and broken ice, while the design of its steel hull ensures that the mission will be completed even after a collision with an intruder vessel.

Defence cooperation with the Indian Navy and Indian industry is particularly noteworthy for SDB. The work started from Pr.61ME frigate. For the first time in the history of Russian shipbuilding, ships of such displacement and characteristics were designed and built for a foreign customer. Five ships of that series were delivered to India.

While cooperating with the Indian Navy, SDB also has worked as a system integrator. Following the request of the Indian Government, the company experts together with the representatives of the Navy defined weaponry and technical equipment to be installed on the ships designed in India. Consequently, Pr.15, Pr.15A, Pr.16, Pr.16 A, Pr.25 and Pr.25A ships were built with indigenous and Russian weaponry installed at the customer's shipyard. Pr. 17 *Shivalik*-class were also created with technical assistance of SDB. The design bureau has been also proud to develop Pr.11356 frigates for the Indian Navy.

Severnoye Design Bureau is in constant search for new technical solutions for implementing them in its products. The company offers its experience to India and looks forward to further beneficial and fruitful cooperation.

Admiral Gorshkov-class frigate

Project 22160 patrol ship

MAKS 2021 (Moscow Airshow)

A Sukhoi Su-57 enthralls the visitors

As always a great show for one and all!

Once the dust had settled at MAKS (20-25 July), Rostec announced that it had signed agreements worth 230 billion rubles at the event. Subsidiaries of Rostec State Corporation signed agreements for the supply of 161 units of various aircraft models. This included UAC to supply 58 SSJ100 airliners and 19 regional IL-114-300 aircraft to customers. Russian Helicopters signed agreements to deliverf 84 helicopters including Mi-171A3, Ka-62, Mi-38, Mi-8 and Ansat.

Rosoboronexport signed 13 export contracts to supply Russian military products worth over 1 billion euros. The list included Su-30SME fighters, Mi-35M and Mi-17V5 helicopters, Protivnik-GE radars, Verba MANPADS, as well as modern aircraft weapons and armoured vehicles.

Novikombank, the core bank of Rostec, signed agreements to finance the production of new helicopters and airplanes, aircraft engines and components, as well as a strategic partnership with the Composite Valley innovation center.

"MAKS-2021 has was truly remarkable, rich in premieres of new products and very productive for the industry as a whole. Rostec exhibited around 500 different products at the air show, 50 of them being completely new aircraft, helicopters, UAVs, avionics, engines and much more. One of these was Sukhoi's new Checkmate tactical fighter, with an unveiling that was widely covered in the international media. The results of MAKS-2021 exceeded all expectations: our companies signed over 230 billion rubles worth of agreements with our partners", stated the head of Rostec, Sergey Chemezov.

Earlier, before the show, Rostec State Corporation had published a picture of its newest fighter aircraft on its official pages on social media which became the most trending news of the days to come. The 'Checkmate' as it was unofficially named, is being spearheaded by PJSC Sukhoi Company. As revealed, the new aircraft will be able to fly at supersonic speeds and be difficult to locate it by radar.

"Currently, Russia is developing several promising aircraft. Besides, Rostec is developing an interceptor of a new generation, which can replace MiG-31BM in the future. In January 2021 this aircraft named PAK DP (a promising long-range intercept aircraft complex) was at the design stage", further stated Chemezov.

Rosoboronexport was the official sponsor of MAKS-2021. "For Rosoboronexport, MAKS was and remains the premier venue to show its partners the best export versions of Russian aircraft and armaments, air defence and electronic warfare assets, including new products no air show in Zhukovsky can do without. In 2021, we invited more than 120 delegations from 65 countries and are going to unveil the IL-

112B, IL-114-300 aircraft, Ka-32A11M, Ansat-M, Mi-171A3 helicopters, as well as the S-350 Vityaz long-range SAM system," stated Alexander Mikheev, Director General of Rosoboronexport.

"In addition, among the new products launched at MAKS-2021, the virtual reality Su-35 and Su-57E pilot station simulators, presented by Sukhoi, will surely be of interest to foreign partners. At our stand in Pavilion C2, Rosoboronexport is showcasing the Globe touch-screen-based interactive multimedia installation. With this installation, visitors will be able to see 38 3D models of advanced defence products, their performance data, and view photos and videos. In addition, scaled models of the IL-76MD-90A(E) military transport aircraft, Mi-35M transport/attack helicopter, Ka-52 scout/attack helicopter, Mi-26T2 heavy-lift transport helicopter, and the Mi-17V-5 military transport helicopter (an export version of the Mi-8MTV-5 helicopter) are on display at the stand. We have also prepared multimedia presentations of products promoted in external markets such as the Su-35, MiG-35/35D, IL-76MD-90A(E) and IL-78MK-90A aircraft, Ka-52, Mi-28NE, Mi-35M, Mi-35P, Mi-17V-5, Mi-8AMTSh-VA, Mi-171Sh and Mi-38T helicopters, air defence systems and equipment: S-400 air defence missile system, Viking, Buk-M2E, Tor-M2KM, Tor-M2 SAM systems, Pantsir-S1M and Pantsir-S1 SPAAGM systems, Verba and Igla-S MANPADS, radars and EW systems", further stated Alexander Mikheev.

President Putin of Russia at the inaugural ceremony

Flags at the site entrance

Rostec starts developing hydrogen-powered aircraft engines

United Engine Corporation of Rostec announced the start of a programme to develop hydrogen-powered engines for both aviation and ground applications. The project was launched in the summer of 2021 with forming a working group and launching R&D work. The announcement was made during the International Aviation and Space Salon MAKS-2021. The working group was formed from specialists of UEC subsidiaries. Development of the power plants will be carried out together with various scientific and industrial institutes, as well as with organisations that have comprehensive experience using hydrogen as fuel.

UEC presents the design concept of new generation aircraft engine PD-8

"High performance and compliance with the latest environmental requirements grant the PD-8 engine a competitive edge on the market. PD-8 will be in line with other engines appearing on the international market during the next decade in terms of reliability, operating safety and maintainability," stated Yuri Shmotin, Chief Designer of UEC. "PD-8's design allows us to create a whole series of modern gas turbine engines with the ability to improve fuel consumption, reduce life cycle costs and strengthen focus on customers and operators."

The project is scheduled for the certification of SSJ-NEW airliner, which will ultimately use the PD-8 engine. Obtaining a type certificate for the PD-8 engine is scheduled for 2023.

UEC initiates second stage testing of the VK-650V

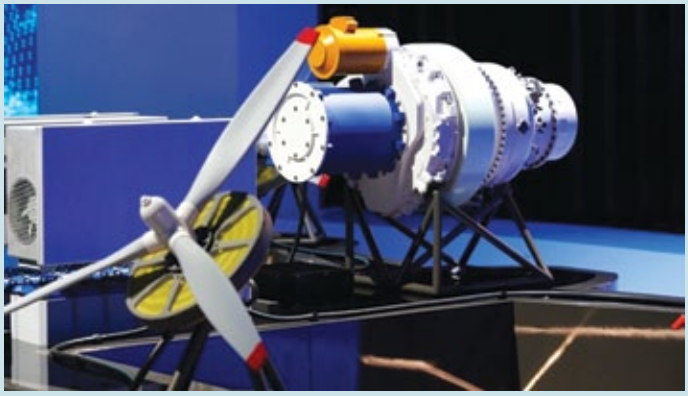
Demonstrator prototype of VK-650V engine developed by UEC-Klimov, subsidiary of the United Engine Corporation of Rostec, has reached the second stage of its testing programme. The engine was exhibited at MAKS-2021. VK-650V has recently completed an intermediate stage of its testing programme, covering tests of its individual components and update on its actual performance characteristics. Now the engine has moved to the second stage of the programme.

UEC-Klimov will proceed with testing the prototypes for required performance and preparing them for the qualifying stages.

The VK-650V engine has a take-off power of 650 hp and is designed to operate in Russian Ka-226T light helicopters. Its modifications can be also installed on Ansat, VRT-500 helicopters and foreign helicopters of the same payload class. Certification is due in 2023.

UEC unveils mock-up of first hybrid engine for aircraft

A mock-up of a hybrid aircraft engine was presented for the first time in the United Engine Corporation (part of Rostec) exhibition at MAKS-2021. The mock-up consisted of a gas turbine engine, electric motors, power electronics units, an electric generator and a battery pack. It is designed for next-generation unmanned aerial vehicles flying with four propellers. The advantages of a hybrid power plant include increased fuel efficiency and flight safety, reduced emissions, increased thrust-to-weight ratio, capability for quick power boosts due to the electrical component, as well as increased service life and reliability.



Rosoboronexport: Air force and air defence products account for 80% of contracts signed in 2021

"This year, Rosoboronexport has signed contract documents worth over $5 billion, 80% of which are for air force and air defence products. MAKS-2021, which will be attended by more than 30 delegations from about 20 countries at our invitation, will be the starting point for new negotiations and new contracts" stated Alexander Mikheev, Director General of Rosoboronexport.

"In Zhukovsky, Rosoboronexports partners will be able to see with their own eyes the aircraft, helicopters, air defence and EW assets promoted by our company, including the absolute novelties from Rostec enterprises – the UAC-developed IL-114-300 new combat aircraft and air platform, as well as Russian Helicopters' products like the Mi-171A3, Ansat-M and Ka-32A11M. In addition, Russia's export bestsellers and potential leaders of the world military aircraft market will be on static display: the fifth-generation Su-57E fighter, MiG-35, MiG-29 and Su-35 fighters, IL-78MK-90A tanker aircraft and IL-76MD-90A military transport aircraft, Ka-52K, Mi-28NE, Mi- 35P, Mi-35M, Ka-226T helicopters and others. On the outdoor display area, Rosoboronexport partners will also view air defence and EW assets promoted by the company abroad. Among them are the latest SAM system Tor-E2 and scale models of the S-400 Triumf and Antey-4000 air defence missile systems as well as the brand-new S-350 Vityaz air defence missile system showcased at the Almaz-Antey stand. Automatika Concern will exhibit the Kupol and Pishchal counter-drone systems, while the Kronstadt Group will unveil the latest Orion-E UAV in a reconnaissance/strike version", further stated Alexander Mikheev.

Sarang's perform at MAKS

The Sarang Helicopter Display Team of the IAF performed for the first time at the MAKS International Air Show, Russia with its HAL Dhruv Advanced Light Helicopters (ALH). The Sarang Team was formed in 2003 at Bangalore and its first international display was at the Asian Aerospace Airshow at Singapore in 2004. Since then, Sarang has represented Indian aviation at air shows and ceremonial occasions in UAE, Germany, UK, Bahrain, Mauritius and Sri Lanka till date. Apart from aerobatics displays at national and international venues, the team has also taken active part in numerous humanitarian assistance and disaster relief missions like Op Rahat in Uttarakhand (2013), Cyclone Ockhi in Kerala (2017) and Op Karuna flood relief in Kerala (2018).

Airbus showcases the A350-1000 and EC145

Airbus demonstrated its new widebody A350-1000, which was shown in the country for the first time along with the twin-engine EC145 rotorcraft. The A350-1000 is the largest member of the clean sheet design A350 widebody Family, with a seating capacity of up to 440 passengers in a single class and the aircraft is powered by Rolls-Royce Trent XWB 97 engines with 15% increased thrust, the aircraft can fly up to 16,100km. More than 70% of the airframe is made from advanced materials, including 53% composites. Aeroflot already operates 6 A350-900.

Another highlight on the static display was the EC145 helicopter – one of the 5 EC145, owned by the city of Moscow and operated by the Moscow Aviation Centre (MAC). Airbus Helicopters and the Moscow Aviation Centre have been cooperating for more than 14 years. During this period, the MAC AH fleet has contributed to saving the lives of more than 6,400 patients in the territory of Moscow.

Rostec's Sergey Chemezov: "Checkmate has a completely unique set of characteristics"

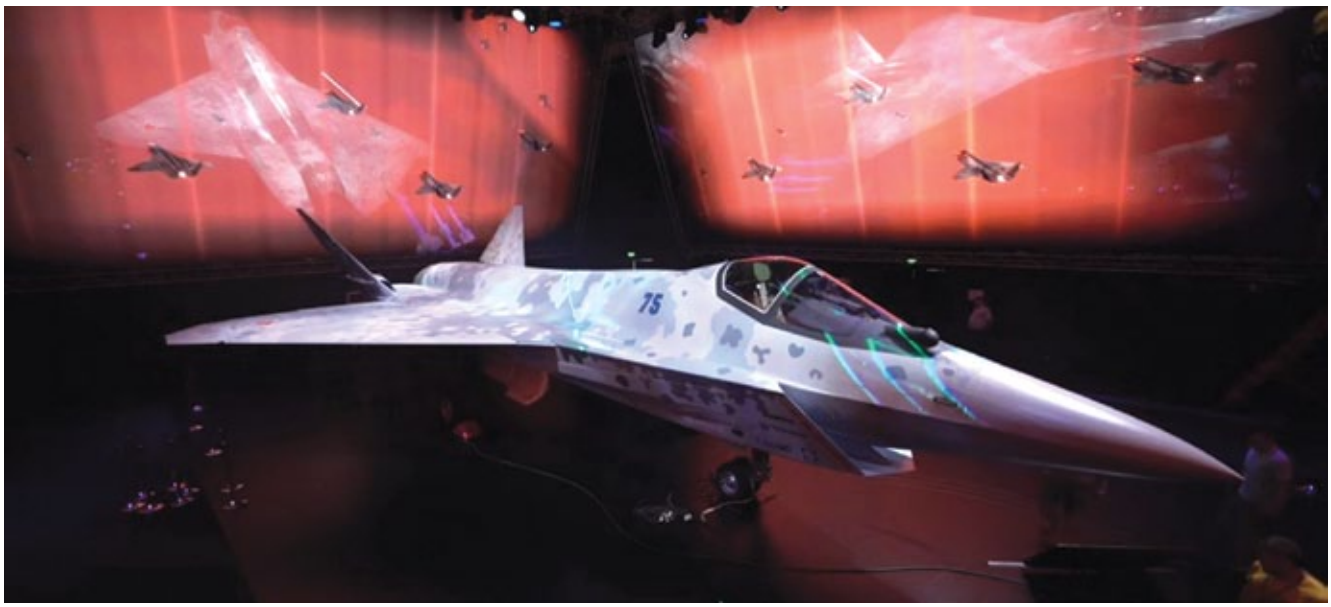
The big premiere of the 15th International Aviation and Space Salon MAKS-2021, opening at Zhukovsky airport near Moscow, was the latest Russian light tactical fighter jet, referred as "Checkmate". The single-engine export-oriented aircraft has been developed by Sukhoi (part of the United Aircraft Corporation of Rostec).

Could you give an introduction of the aircraft that was unveiled today?

It is a fifth generation fighter with stealth capabilities and high flight performance. The model is equipped with advanced avionics and most capacious weapon bays within its class. In its stealth configuration, Checkmate is capable of carrying up to five air-to-air missiles of various ranges, as well as other weapons. We actively used supercomputer technologies during the creation process, allowing to significantly save both time and funds spent on development and testing. The aircraft has a completely unique set of flight and combat characteristics, while maintaining an affordable price and relatively low operating cost per flight hour. For example, it has a maximum combat payload of 7,400 kilogrammes and flight range of 2,900 kilometers without additional fuel tanks. These are remarkable numbers for a light single-engine plane. I would like to note that this is not just a fighter jet, but a high-tech smart aviation platform, with open architecture and adaptability: it can be assembled in several configurations, based on concrete requirements of the customer. It also holds great potential for further modernisation. The key concept of the project is summarised by its name, Checkmate. The role of the plane is similar to the knight piece from chess: maneuverable and capable of executing unexpected moves that decide the course of the game. The plane has a prototype that is ready for testing.

How does its design differ from older Su-57 or Su-35 models?

Both Su-57 and Su-35 are unique planes by their own right, you could call them as part of the "major league". Nevertheless, their capabilities are limited and not fit for particular missions. Checkmate is a "lightweight" platform, optimal for solving urgent tasks with minimal financial costs. It has very high level of combat effectiveness considering its relatively low cost and cheap flight hour. Its advanced modern avionics allow it to engage in air combat and attack ground attacks with active phased array



radar, providing effective targeting capabilities even under strong electromagnetic interference. At the same time, its own electronic warfare equipment allows the plane to avoid detection and evade enemy weapons. Checkmate can use a full range of weapons to fight against any air, land, sea targets, as well as counteract most advanced anti-air defence systems.

How would you assess the export potential of the aircraft, what markets is it focused on?

Without a doubt, Checkmate has high export potential. It is capable of solving wide range of objectives faced by different customers, effectively destroying land and sea targets, and fighting for air supremacy against a numerically superior enemy. The combination of high combat payload, modern equipment and low cost per flight hour makes the aircraft extremely cost-effective considering its combat capabilities. The flexible use of various configurations allows to accurately customise it to meet the needs of almost any potential customer. We are offering the platform equipped with wide selection of modern avionics and armament. Each customer can choose exactly what he needs. Currently, potential customers include the countries of the Middle East, Asia- Pacific and Latin America.

How will the after-sales service system work?

The Matryoshka automated logistic support system was specially created for this aircraft. It allows organising personnel training, planning maintenance with high precision and delivering necessary components on time. The system will reduce after- sales service costs while increasing its efficiency, and ensure a high level of combat readiness of the fleet, even during high-intensity operations.

What plans do you have to further improve this platform?

Checkmate is the combat system of the future. It is possible to create an unmanned version of the plane based on unified aviation platform. Future versions will be able to execute coordinated group operations with both manned and unmanned vehicles, combined into one system. Unmanned wingmen will be able to exchange information, instantly react to a changing combat situation, and automatically distribute and perform even the most complex tasks. This will significantly increase the overall awareness of the platform, expand combat capabilities and allow introducing completely tactics for combat operations.

Interview courtesy: Rostec
Photos: MAKS PR Team

Russian Helicopters at MAKS-2021 and ARMY-2021

Maintenance contract for Brazilian Air Force Mi-35M's

A contract has been signed by Russian Helicopters holding company (part of Rostec State Corporation) with Industria de Aviacao e Servisos (IAS), an authorised company of Brazilian Air Force. Helicopters will be repaired in the IAS service centre established as part of Russia's offset obligations under the contract for supplying 12 Mi-35M helicopters.

Russian Post to launch drones for cargo

Russian Helicopters has signed an agreement with Russian Post for the use of unmanned aircraft (drones) in the Chukotka Autonomous District. The signing ceremony took place at the International Aviation and Space Show MAKS-2021. Companies will conduct the first test flights along the Anadyr-Ugolnye Kopi route in Chukotka by the end of 2021. Following experimental flights, the parties plan to run unmanned aircraft on 20 routes and use them to deliver up to 245 tons of mail per year. Two Russian Helicopters drones, the latest BAS-200 and VRT300 will be used for cargo delivery.

BAS-200 in MAKS 2021 flight programme

Russian Helicopters presented its new UAV, the BAS-200, at MAKS-2021 and it became the first UAV to take part in the flight programme. The maximum take-off weight for the BAS-200 is 200 kgs. Capable of speeds up to 160 kms per hour, it can carry commercial loads of up to 50 kgs. The BAS-200 can fly for up to 4 hours at altitudes of up to 3,900 metres.

New Ka-226T presented at MAKS-2021

JSC Russian Helicopters presented the Ka-226T Climber helicopter at the MAKS-2021 International Aviation and Space Salon. The new model is the latest variant in the Ka-226 family. The Ka-226T Climber is "ideal for flying in mountainous areas and its coaxial rotors allow for easy control even at the highest altitudes with rarefied air". It boasts high resistance to strong side winds, and high rate of climb, as well as easy take-off and landing at high-altitude sites. The Ka-226T Climber also performs well in flights over water, and can take off and land on the deck of even a small seagoing vessel.

Mi-171A3, Ka-32A11M and Ansat-M unveiled

Russian Helicopters presented several brand new civil helicopters at the MAKS-2021 air show: the Mi-171A3, the Ka-32A11M, and the Ansat-M. The new Mi-171A3 is the first Russian helicopter designed for offshore operations and servicing offshore drilling rigs. Developed in accordance with International Association of Oil and Gas Producers (IOGP) standards, the helicopter fully complies with the high safety requirements associated with offshore flights. Another new model to be presented at MAKS-2021 was the modernised light helicopter Ansat-M. Having made its first flight at the end of 2020, the Ansat-M has already completed certification tests for its expanded fuel system, and more than confirmed its stated 640 km range. With an extra fuel tank, the range can be increased to 790 km, which is an important factor for many Russian and global operating companies. Thanks to its new avionics and modern autopilot system, the Ansat-M is capable of instrument flight. The improved aerodynamics of the new main and tail rotor blades make for better flight characteristics overall, increasing the takeoff weight to 3,800 kg and reducing noise levels both in the cabin and outside the aircraft.

Rostec to supply 50 Mi-8AMT's to UTair

Russian Helicopters/Rostec signed a contract with UTair Helicopter Services for 50 Mi-8AMT helicopters. Andrey Boginsky, Director General of Russian Helicopters and Andrey Martirosov, CEO of UTair signed the document and the helicopter deliveries are to begin in 2022.

New Mi-171SH Storm at Army-2021

An upgraded Mi-171Sh Storm military transport helicopter arrived under its own power from Ulan-Ude aviation plant of Russian Helicopters at the international military-technical forum Army-2021. The Mi-171Sh Storm helicopter is specially designed to carry out counter-terrorism missions by Special Forces. The helicopter is equipped with high-altitude increased power engines, a new rotor system with an improved profile composite main rotor and X-shaped tail rotor, an integrated flight and navigation system, and most importantly - an improved composition of weapons and defence systems.

Improving crew and trooper safety was one of the key goals of the upgrade. That is why the Mi-171Sh Storm has improved armour protection on the fuselage, which guarantees mission performance even in fire resistance counteraction. In particular, the onboard defence system provides enhanced survivability and protection. The onboard defence system (ODS) can detect anti-aircraft missile launches and jam portable anti-aircraft missile systems (MANPADS). The onboard defence system has an innovative feature to instantly display aerosol smoke screens to cover the loading and unloading of troops. This will protect from, among other things, detection by thermal imaging devices.

Gazprom for the Mi-171A3

Gazprom and Russian Helicopters signed a cooperation agreement to supply the first Russian offshore helicopter. Mi-171A3 helicopter meets the increased safety requirements for flights over the water surface. In particular, it will be equipped with an emergency-resistant fuel system, an auto-activated emergency water landing system, and external life rafts.

U-UAP presents the Ka-226T Climber at ARMY-2021

Ulan-Ude aviation plant of Russian Helicopters Holding (Rostec State Corporation) presented its light multipurpose Ka-226T Climber helicopter, which will begin flight tests this fall. The modernised Ka-226T helicopter serial production is scheduled to start in 2022 in close cooperation with Kumertau aviation manufacturing company at the Ulan-Ude aviation plant facility.

Russian Helicopters cockpit of the future presented at Army-2021

Russian Helicopters presented a mockup cockpit of the future with modern ergonomics and functionality. This mock-up will allow mastering several technologies at once, including the use of sensory glass cockpit application, forecasting system and pilot's decision-making support and so on. The ergonomic cockpit mock-up research work is aimed for flight safety improvement, as well as reliability and efficiency of helicopter crews. The information and control field of the future helicopter cockpit is formed in such a way as to reduce the crew's psychophysical and intellectual workload while in flight, as well as to maintain its full situational awareness.

Russian Helicopters signs first contract for upgraded Ka-52M

Russian Helicopters Holding Company (a part of Rostec State Corporation) at the international military and technical forum Army-2021 signed a contract with the Ministry of Defence of the Russian Federation to supply the first modernised attack helicopters Ka-52M. The first rotorcraft is to be delivered in 2022. The scheduled deliveries for this modernised helicopter is to begin after state joint tests have been completed which starts in August.

«The Ka-52 is one of the best attack helicopters in the world, but even the best aircraft needs timely modernisation, which will expand its combat capabilities,» stated Andrey Boginsky, Director General of Russian Helicopters. "With the updated version in development, our designers drew on the experience of Alligator's operation, including in real combat situations. Therefore, everything in the modernised attack helicopter is aimed at improving combat effectiveness in all weather conditions. Under an agreement with the Russian Ministry of Defence, preparations for serial production have already begun at the AAC "Progress" facility in the Primorye".

Ka-52M has received a modernised avionics suite and equipped with more powerful computers for better performance. With its support, the weapon's application capabilities have been expanded, including in night conditions. The target range of detection and recognition at night has been doubled. The helicopter has installed and tested advanced missile weapons and the Ka-52M is adapted to work in conjunction with UAVs. The data obtained from the drones will help the crew to increase situational awareness on the battlefield and help significantly improve intelligence gathering at a greater distance.

To increase the helicopter's efficiency, intensive work is underway to install a radar station with an active phased antenna array (APAR). The combat radius has been increased and the helicopter is also equipped with an upgraded BLC (On-Board Load Control System).

Rosoboronexport signs 20 contracts worth €2 billion at Army 2021

Rosoboronexport JSC (part of the Rostec State Corporation) held more than 70 negotiations with representatives of 35 countries during Army 2021 International Military-Technical Forum.

"As a result of negotiations with foreign partners held at the Army 2021 Forum, Rosoboronexport has signed about 20 contract documents totaling over €2 billion," stated Alexander Mikheev, Director General of Rosoboronexport.

According to the agreements concluded with foreign customers, Rosoboronexport will export Russian defence industry products for all services of the armed forces, as well as electronic warfare and air defence equipment in the coming years. Among them are the Su-30 type aircraft, Mi-35P, Mi-171SH and Mi-17V-5 helicopters, air weapons, Pantsir-S1 self-propelled anti-aircraft gun/missile (SPAAGM) system, Kornet-EM ATGM system, remotely controlled weapon stations, weapons for surface combatants and submarines, small arms and short-range weapons and various types of ammunition.

"The agreements reached by Rosoboronexport to supply foreign customers with the latest Pantsir-S1M SPAAGM system, Krasukha electronic warfare (EW) system and the Repellent-Patrol mobile counter-drone EW system are

the first export contracts for these weapons," Alexander Mikheev further added. "In addition, for the first time in the history of military-technical cooperation between Russia and foreign countries, we have agreed to integrate Russia's Palma shipborne gun/missile CIWS into a ship's foreign-made weapons system."

Live demonstrations of weapons, military and special equipment, organised by the Russian Ministry of Defence and Rosoboronexport for the company's foreign partners, was a highlight of the forum. The event involved Russian weapons and equipment for the ground forces and army aviation promoted by Rosoboronexport in external markets and was held at the Alabino Proving Ground.

At Kubinka Airfield, Rosoboronexport partners got acquainted with more than 40 types of aviation equipment, as well as observed flights of aerobatic teams and more than 25 solo flights.

The foreign guests invited by Rosoboronexport viewed Russian small arms in the company's presentation pavilion and at manufacturers' stands, while the company's partners were able to personally test the main small arms models at Kalashnikov Concern, High-Precision Weapons Holding Company, Tochmash Central Research Institute and Lobaev Arms' shooting ranges.

Among the new products presented at Army 2021 by Rosoboronexport, Russian defence industry and the Russian Ministry of Defence, foreign partners paid special attention to the T-14 Armata tank, combat vehicles based on the Boomerang combat platform, Orion-E reconnaissance/strike UAV, Antey-4000 air defence missile system, Pantsir-S1M SPAAGM system, Su-57 fifth-generation fighter, BMP-3 IFV with the Berezhok turret, modern Russian security equipment, the latest small arms amongst other equipment.

GA-ASI MQ-9A Block 5 for Netherlands

General Atomics Aeronautical Systems has announced the completion of the first MQ-9A Block 5 Remotely Piloted Aircraft (RPA) and Ground Control Station (GCS) for the Royal Netherlands Air Force (RNLAF). GA-ASI and RNLAF commemorated the occasion with a special roll-out ceremony at GA-ASI's corporate headquarters in Poway, Calif., and the event was simulcast to the Netherlands.

Raytheon next gen jammer mid-band production

Raytheon Intelligence & Space has been awarded a $171.6 million contract for Low-Rate Initial Production Lot I, or LRIP I, of the US Navy's Next Generation Jammer Mid-Band. NGJ-MB is the Navy's advanced electronic attack system that offensively denies, disrupts and degrades enemy technology, including air-defence systems and communications. NGJ-MB uses the latest digital, software-based and Active Electronically Scanned Array technologies.

Safran Arrano 1A obtains FAA certification

Safran Helicopter Engines has received FAA (Federal Aviation Administration) type certification for its Arrano 1A engine, installed in the Airbus H160 helicopter. Arrano is a new-generation turboshaft in the 1,100 to 1,300 shp power range. Arrano innovative

design features a new-generation digital control system that offers greater in-flight responsiveness, enhancing both safety and pilot handling. It combines a highly efficient two-stage centrifugal compressor, with new-design variable inlet guide vanes (IGV).

V2500 engines surpass 250 million flight hours

Pratt & Whitney has announced that the International Aero Engines AG (IAE) V2500 engine has surpassed 250 million engine flight hours of operational experience. Currently powering more than 3,000 aircraft and serving more than 200 customers, the V2500 engine operates passenger, cargo, and military missions around the world. "In the 2000s our V2500 engines on IndiGo's order of 100 A320s helped usher in the new age of private aviation in India," stated Ashmita Sethi, President & Country Head, Pratt & Whitney. "We are very proud that until today the V2500 has powered the growth of Indian aviation and continues to deliver reliability and performance for Indian airlines, even in the current environment. This milestone is a testament to the V2500's track record of success."

Porter Airlines for 80 Embraer E195-E2s

Porter Airlines has unveiled plans to extend its service to destinations throughout North America with a firm order for 30 Embraer E195-E2 jets, with purchase rights for a further 50 aircraft.

CAE and Volocopter to partner

CAE, a global leader in aviation training, and Volocopter, a leading pioneer of urban air mobility (UAM), announced the signing of a strategic partnership, subject to definitive agreement, to develop, certify and deploy an innovative pilot training programme for electric vertical takeoff and landing (eVTOL) operations.

NGC's SABR radar goes agile

Northrop Grumman has adopted Lean-Agile methodologies in the development and integration of the active electronically scanned array (AESA) AN/APG-83 Scalable Agile Beam Radar software for the F-16 Viper fighter aircraft. The transition to Lean-Agile was achieved in partnership with the US Air Force development teams at Hill Air Force Base, Eglin Air Force Base and Air National Guard Air Force Reserve Command Test Centre.

PAC-3 and F-35 team up

A Lockheed Martin PAC-3 missile successfully intercepted a surrogate cruise missile threat at White Sands Missile Range (WSMR), New Mexico, using F-35 as an elevated sensor. The mid-July US Army flight test marks a first in one flight test – F-35 data contributing to the global track used by the U.S. Army Integrated Air and Missile Defence Battle Command System (IBCS) to live fire a PAC-3. IBCS, developed by Northrop Grumman, used the F-35 data with other contributing sensor data to initiate the launch of the PAC-3 to neutralise the incoming threat, using combat-proven Hit-to-Kill technology unique to the Lockheed Martin interceptor.

Bell begins manufacturing UH-1Y

Bell Textron has restarted UH-1Y Venom helicopter production for the first international operator. Crestview Aerospace has completed manufacturing the first of eight cabins at the Crestview Florida facility. The aircraft will complete final assembly at the Bell Amarillo Assembly Center. The helicopters are part of the 2020 US Department of Defence contract awarded to Bell for the production and delivery of eight UH-1Y and four AH-1Z helicopters for the government of the Czech Republic.

Leonardo's AW101 for the Polish Navy flies for the first time

Leonardo announced that the Polish Navy's first AW101 (ZR285) has achieved its first flight at the Company's site in Yeovil. The AW101 for the Polish Naval Aviation Brigade will be equipped with the most modern mission systems, including autopilot with SAR modes, data transmission system, tactical navigation system and protection and defence systems (passive and active). In addition, the AW101 will be equipped with a tactical radio, reconnaissance radar, an observation head (FLIR) and an S-mode transponder.

Thales to provide new avionics equipment for Rafale

Thales has been awarded the contract to supply Scorpion helmet-mounted sight and display systems and digital multi-function displays for all the Dassault Aviation Rafale aircraft in service with the French Air and Space Force and the French Navy. Coupled with the aircraft's weapon systems, the Scorpion helmet-mounted sight and display enhances tactical situational awareness and enables crews to respond more quickly and with greater agility to a whole range of threats.

GA-ASI and UK MOD for more Protector RPAS

The UK Ministry of Defence (MoD) has exercised the clause in its contract with General Atomics Aeronautical Systems, Inc (GA-ASI) to manufacture and deliver 13 additional Protector RG Mk1 Remotely Piloted Air Systems (RPAS) that had previously been identified as options. The initial contract order was for three Protector RPAS, establishing 16 as the new total of Protectors to be delivered to the UK MoD.

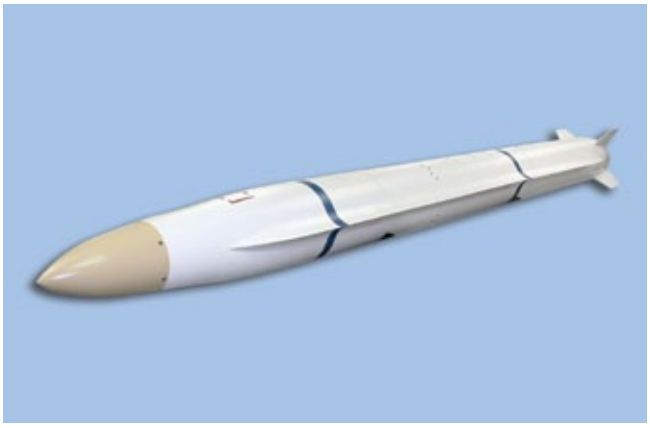
Bell unveils new HSVTOL design concepts

Bell Textron announced the unveiling of design concepts for new aircraft systems for military applications which would use Bell's High-Speed Vertical Take-Off and Landing (HSVTOL) technology as the company continues its innovation of next generation vertical lift aircraft. HSVTOL technology blends the hover capability of a helicopter with the speed, range and survivability features of a fighter aircraft.

MQ-4C Triton completes 1st flight in multi-intelligence configuration

A Northrop Grumman Corporation built MQ-4C Triton took to the skies for the first time in the highly upgraded multi-intelligence configuration known as integrated functional capability four (IFC-4). Triton is the US Navy's premier high-altitude, long-endurance (HALE), maritime intelligence, surveillance and reconnaissance (ISR) platform. Northrop Grumman is working closely with the Navy to progress Triton toward initial operating capability (IOC) and world-wide deployments.

NGC's AARGM-ER completes 1st missile live fire



The US Navy has successfully completed the first live fire of the Northrop Grumman AGM-88G Advanced Anti-Radiation Guided Missile Extended Range (AARGM-ER) from a US Navy F/A-18 Super Hornet. The missile successfully demonstrated the long range capability of the new missile design. AARGM-ER leverages AARGM with significant improvements in some technology areas.

Georgia to purchase Javelin missiles

The US State Department has made a determination approving a possible Foreign Military Sale to the Government of Georgia of Javelin Missiles and related equipment for an estimated cost of $30 million. The Government of Georgia has requested to buy eighty-two Javelin FGM-148 missiles and forty-six Javelin Command Launch Units (CLU).

Next-gen vehicles show their firepower

The two contender vehicles for Australia's soon-to-be-selected infantry fighting vehicle (IFV) (LAND 400 Phase 3 project) recently conducted a firepower demonstration at Puckapunyal Military Area, showcasing next-level protection, firepower and mobility. Rheinmetall Defence Australia's KF-41 Lynx and Hanwha Defense Australia's Redback have been facing off in extensive user-evaluation field trials. Both companies have delivered three prototype vehicles, which are being tested over the course of this year as part of a two-year risk mitigation activity.

Japan for RAM Block 2 tactical missiles

The US State Department has made a determination approving a possible Foreign Military Sale to the Government of Japan of RAM Block 2 Tactical Missiles and related equipment for an estimated cost of $61.5 million. The Government of Japan has requested to buy up to forty-four (44) Rolling Airframe Missiles (RAM) Block 2 Tactical Missiles, RIM-116C.

TECRO for 155mm M109A6 Paladin systems

The US State Department has made a determination approving a possible Foreign Military Sale to the Taipei Economic and Cultural Representative Office in the United States (TECRO) of 155mm M109A6 Paladin Medium Self-Propelled Howitzer System and related equipment for an estimated cost of $750 million. TECRO has requested to buy forty 155mm M109A6 Medium Self-Propelled Howitzer Systems; twenty M992A2 Field Artillery Ammunition Support Vehicles (FAASV); one Advanced Field Artillery Tactical Data System (AFATDS); five M88A2 Hercules vehicles; five M2 Chrysler Mount .50 caliber machine guns; and 1,698 multi-option, Precision Guidance Kits (PGK) etc.

Eurofighter and NETMA contract for Typhoon

Eurofighter Jagdflugzeug GmbH and NETMA, the NATO Eurofighter & Tornado Management Agency, have signed a contract worth close to €300 million, which provides the next steps in the capability evolution of the Eurofighter Typhoon combat aircraft. The Consolidation Package Step Two and Three, Phase 1 Contract's most important elements include Typhoon capability enhancements when operating the Meteor beyond-visual-range, air-to-air missile, with the capability implementation being transferred from the current M-Scan to the new E-Scan radar.

USAF awards contract to Hermeus

In an effort to accelerate the commercial development of hypersonic aircraft and propulsion systems, the US Air Force is investing in the Hermeus Corporation – a US based aerospace company – via a $60 million jointly funded contract that was awarded recently. Currently, the company is developing a hypersonic aircraft capable of flying at five times the speed of sound. At this speed a flight from New York to Paris would only take 90 minutes, compared to the seven and a half hours it typically takes today. The contract is being funded by the Air Force Life Cycle Management Center's Presidential and Executive Airlift Directorate, the Air Force Research Laboratory (AFRL), and various venture capital sources.

Successful PAC-3 flight tests

In flight tests at White Sands Missile Range in August 2021, Lockheed Martin demonstrated new upgrades to its PAC-3 Missile Segment Enhancement (MSE) interceptor and continued reliability of its PAC-3 Cost Reduction Initiative (CRI) interceptor. During the tests, a PAC-3 MSE succesfullly intercepted a tactical ballistic missile target, validating missile and laucher software and hardware component upgrades.

Bell 360 Invictus makes significant progress

Bell Textron has released new data on the build and testing for the Bell 360 Invictus competitive prototype. The Bell 360 programme is rapidly progressing through manufacturing, assembly, components testing, and systems integration work for the US Army's Future Attack Reconnaissance Aircraft (FARA) programme. The team has completed multiple design and risk reviews with the Army and is on schedule for all programme requirements.

Netherlands to procure LMT's PAC-3 MSE

US and Dutch officials have formalised an agreement for the Netherlands to purchase Lockheed Martin's PAC-3 Missile Segment Enhancement (MSE) interceptors and related support equipment. With the signing, the Netherlands becomes the 12th customer of PAC-3 MSE and advances its missile defence technology from the PAC-3 Cost Reduction Initiative (CRI) the country acquired in 2004.

United Rotorcraft for five S-70 Black Hawks

United Rotorcraft, a division of Air Methods Corporation, has awarded Sikorsky, a Lockheed Martin company, a contract for five S-70 Black Hawk helicopters. The bulk order will enable United Rotorcraft, as the only company authorised by Sikorsky to modify Black Hawk aircraft to the Firehawk configuration, to quickly deliver these new production aircraft for aerial firefighting in support of public agencies battling increasingly destructive wildland fires.

Embraer delivers its 1,500th business jet, a Phenom 300E

Embraer, early September, delivered its 1500th business jet, an impressive accomplishment achieved in only two decades, while the industry average to reach this mark is 34 years. The milestone aircraft is a Phenom 300E, the best-selling light jet for nine years in a row, which was delivered to Haute Aviation, a Swiss company focused on charter, brokerage, and aircraft management.

Two is good!

On 8 September, two Casa-295s were seen at Eindhoven AB (NL). A Polish Air Force C-295 was present for the multinational FalconLeap cargo and paradrop exercise. During this exercise it flew together with C-130s from the Netherlands, Italy and the United States Air Force. A Finnish Air Force Casa-295 too visited Eindhoven AB for a short stop.

Text and image by Joris van Boven

Rise of Asian Stealth

Model of the proposed AMCA for the IAF on display at Aero India 2021 (Photo: Vayu)

27 August 1990 marked a red letter day when Northrop Grumman conducted the first flight of the world's first fifth generation fighter jet YF-23. Thus the US became the first nation to achieve this remarkable breakthrough in aviation technology. Though Russia and China have developed their own counterparts but are certainly no match for US assets at this moment. While, the progress of US, Russia and China in complex and sensitive stealth technology is in the limelight, at least four Asian nations other than China are working tenaciously to reach this zenith. Once successful, these five nations will proudly announce the Asian era of complex aviation technology.

China

China's quest for superior aviation technology can be traced back to several decades. Shenyang Aircraft Corporation and Chengdu Aircraft Corporation were engaged in rivalry but at the end CAC won the contract. J-20 was inducted in 2017 and 150 units reported to be manufactured. Meanwhile, Shenyang developed another stealth platform popularly known as J-31. Initially it was to be an export platform only, but now reportedly will be used by PLAAF as well. China is working on a carrier borne version of it for Type 003 and future aircraft carriers. It is evident there are a lot of shortcomings in these platforms but China is gradually overcoming them.

India

India is currently engaged in development of multiple platforms. While the LCA Mk.1, Mk.1A and Mk. 2 will bridge the gap to replenish a large part of the IAF's retiring fleet, IAF will need a next generation platform to meet future requirements. And this is where the AMCA is going to play a very important role. An initial amount of Rs 90 crore was allocated for the feasibility study, then sanction for the design phase accorded in December 2018 with an allocation of more than Rs 400 crore. It is reported an unmanned version also will be developed for the future. Five prototypes of AMCA will be developed in a proposed public-private joint venture. Taxi trials of the AMCA are aimed for 2024-25 with the first flight expected to be conducted by 2025-2026 and entering production by 2029. Series production of AMCA Mk.2 version is expected to be by 2035.

Turkey

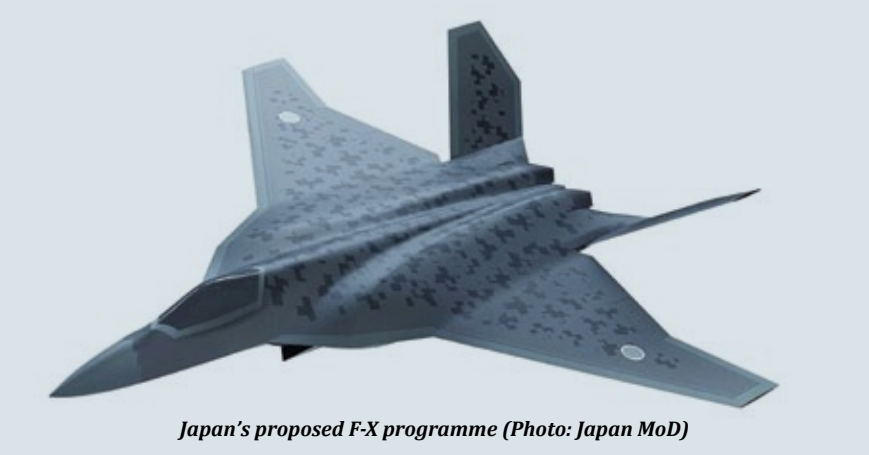
TAI TF-X is a fifth generation multi-role platform being developed by Turkey to replace the current F-16 fleet. According to recent reports the project has reached the System Requirements

Mockup of Turkey's TAI TF-X at the Paris Airshow 2019 (Photo: Vayu)

Review (SRR) phase and will be followed by the System Functional Review and Preliminary Design Review. The prototype is expected to be unveiled in March 2023. Turkey has recently announced that a foreign cooperation for the development is important to overcome technology shortcomings. BAE Systems is providing technological assistance. Dassault Systems is to provide flight control software which later might be replaced by indigenous one by TAI and Havelsan. TAI will develop actuators in partnership with Altınay of Ukraine. Aselsan will provide avionics and computer hardware, TÜBITAK to provide central computers and Pavotek is developing power distribution system. Kale Group in partnership with Rolls Royce to develop the engine. But the situation is much more critical than it looks. Ankara is not on good terms with US and European Nations. US not only has removed Turkey from the F-35 programme but also put sanctions thus squeezing foreign technology assistance to Turkey. A total of 250 platforms are to be inducted.

Japan

Mitsubishi Heavy Industries of Japan is developing the nation's next generation fighter aircraft F-X based on the technology demonstrator X-2 Shinshin and i3 conceptual proposal. Despite being a world leader in the field of technology, the limitations in its aviation sector have forced Japan to seek foreign collaborations. Potential partners include Lockheed Martin, Boeing Defence and BAE Systems. Northrop Grumman will provide technical assistance and Lockheed Martin will help in development of the airframe. IHI Corporation is developing the engine which once successful will enable thrust vectoring. Toshiba and Fujitsu is engaged in development of Gallium Nitride based Active Electronically Scanned Array Radar. The radar claims to be supplemented by an infrared sensor and an electromagnetic sensor (ESM) thus providing robust defence against enemy air-to-air missiles. Many other companies will be involved in the development of several critical technologies. The platform will have a very low radar profile, light weight by composite materials, fiber-optic flight control systems, sophisticated mission statement, advanced electronic warfare capability, new generation helmet mounted display (HMD), Integrated Fire Control for Fighters (IFCF) system etc. The first flight is expected by 2028. Japan plans to induct 90 such platforms, all entering into service by 2035.



Japan's proposed F-X programme (Photo: Japan MoD)

South Korea

South Korea is another player progressing fast in the aviation field and unveiled the KAI KF-21 Boramae on 9 April 2021. Like Turkey and Japan, South Korea too is developing critical technologies with foreign collaborators. Hanwha Techwin signed an agreement with General Electrics to manufacture a variant of GE F414 to power the platform. Hanwha Systems will develop the AESA radar in collaboration with Elbit Systems and Elbit will also provide terrain-following/terrain avoidance (TF/TA). Whereas LIG Nex1 will work with Saab for software development and evaluation, Triumph Group will provide airframe mounted accessory drives (AMADs) which plays a key role in transfer of engine power to other systems. Texstars will develop the canopy and high resistance transparencies. Besides Cobham, Martin-Baker, Curtiss-Wright and MBDA, many others are involved in this highly sensitive project. If everything goes well, the first flight of the system will be conducted in 2022. 120 platforms are expected to be delivered by 2032. Indonesia had been invited for joint development of the project but due to financial differences it didn›t progress much. Indonesia may acquire 48 IF-X's, a variant, if negotiations are successful.

While Asian nations are progressing fast in this field, it cannot be denied that limitations in indigenous technologies will hinder these programmes. This is why almost every nation is determined to develop necessary systems in collaboration with foreign counterpart specialists in their respective fields. Whatever be the challenges, in next 15 years, Asia is determined to shine in aviation technology.

Sankalan Chattopadhyay
(Twitter @Vinoddx9)

South Korea's KAI KF-21 Boramae

Updates from BAE Systems

Advanced CV90 offered to Czech Army

BAE Systems has confirmed its bid submission to provide the CV90 to the Czech Ministry of Defence for the BMP II Replacement Programme. In partnership with state-owned defence integrator VOP CZ s.p., the team's offer will ensure the production and delivery of the CV90 MkIV Infantry Fighting Vehicle on schedule and to budget.

BAE Systems sustainment contract for AMPV

The US Army has awarded BAE Systems a contract worth up to $600 million for the sustainment and support of the Armoured Multi-Purpose Vehicle (AMPV) over the next five years. The AMPV comes in five variants designed to execute a broad set of missions while operating on the front lines.

Next-gen missile warning system

BAE Systems has received a $62 million contract from the US Army to deliver the next-generation 2-Color Advanced Warning System (2CAWS). The system provides aircrews with advanced threat detection capabilities, improving survivability and mission effectiveness in contested environments.

Next-generation stealth missile seekers

BAE Systems has received a $117 million contract from Lockheed Martin to produce next-generation missile seekers for the Long Range Anti-Ship Missile (LRASM). The seeker technology enables LRASM to detect and engage specific maritime targets in contested environments with less dependence on traditional navigation systems.

New APKWS guidance kits improve rocket range and impact

BAE Systems has developed an advanced version of its APKWS guidance kit that offers enhanced strike distance and precision strike lethality. The upgrade improves the effective range of APKWS guided rockets by up to 30%, allowing warfighters to engage targets from a greater standoff distance with improved survivability. APKWS is the US government's only programme of record for guiding 2.75-inch laser-guided rockets, providing an efficient, low-cost weapon in the US arsenal of precision munitions.

Sustaining EW system readiness for F-35s

BAE Systems has received a $93 million, five-year Undefinitised Contract Action from Lockheed Martin to provide critical sustainment support for the AN/ASQ-239 electronic warfare (EW) countermeasure system. The contract will ensure the mission readiness of the growing global fleet of F-35 aircraft.

Updates from Israel

IAI selects RTI Connext for OPAL

Real-Time Innovations (RTI), the largest software framework company for autonomous systems, announced Israel Aerospace Industries (IAI) has selected RTI Connext DDS for real-time connectivity as part of its Operational Avionics Layer (OPAL) Application Framework. IAI's OPAL serves as the infrastructure for networking connectivity, data sharing, and operative actions for air, land and naval forces. By using Connext to manage data communications, IAI is able to help customers in the defence industry implement new applications in a fraction of the time while reducing operational costs, decreasing development complexity, and enabling faster time to market. In addition, the OPAL application framework built on Connext DDS will readily enable companies to meet Modular Open Systems Approach (MOSA) programme requirements

Rafael fires SPIKE NLOS from JLTV

Rafael Advanced Defense Systems and Oshkosh Defense have completed a successful demonstration and live firing of Rafael's SPIKE NLOS (Non-Line-Of-Sight) missile from an Oshkosh JLTV (Joint Light Tactical Vehicle). SPIKE NLOS is a fifth generation, 32 km-range missile, with high effectiveness achieved by a navigation system and lethal warheads capable of destroying a wide range of targets.

Rafael contract in Asia for naval warfare systems suite

Rafael Advanced Defense Systems has been awarded a contract worth approximately $80 million to supply a comprehensive naval warfare systems suite for Shaldag Mk V Fast Attack Crafts

by Israel Shipyards, to an undisclosed country in Southeast Asia. The contract will be fulfilled over the course of three years. Rafael will supply its client with an advanced naval warfare systems suite, which includes a Combat Management System (CMS), Typhoon and Mini-Typhoon Remote Operating Weapon Systems, Naval Spike Missiles, Sea-Com Internal Communication System and BNET Tactical Data Link, as well as other components with full maintenance and support services.

IAI to produce F-16 wings for Lockheed Martin

Israel Aerospace Industries (IAI) has resumed the production of F-16 wings for Lockheed Martin, using the assembly line established in the 1980s. IAI recently reopened the production line following increased worldwide demand for the F-16 Block 70/72. IAI will produce F-16 wings that will be shipped to the F-16 final assembly line in Greenville, South Carolina, USA.

The world of Airbus

First A350 from delivery centre in China

Airbus has delivered the first A350 from its widebody completion and delivery centre in Tianjin (C&DC), China, taking additional steps in the expansion of its global footprint and long-term strategic partnership with China. The A350-900 aircraft was delivered to China Eastern Airlines, the largest Airbus operator in Asia and second largest in the world. At the end of June 2021, China Eastern Airlines operated an Airbus fleet of 413 aircraft, including 349 A320 Family aircraft, 55 A330 Family aircraft and nine A350 aircraft.

Jet2.com orders 36 A321neos

Jet2.com has placed an initial order for 36 A321neos making the airline based in Leeds, United Kingdom, a new Airbus customer and a new Airbus A320neo Family operator. Engine selection will be made at a later date.

Delta Air Lines for 30 Airbus A321neo's

Delta Air Lines has ordered 30 additional Airbus A321neo aircraft to help meet the airline's future fleet requirements. The newly-ordered aircraft are in addition to the airline's existing orders for 125 of the type, bringing the outstanding orders from Delta to a total of 155 A321neos.

Kazakhstan orders two Airbus A400Ms

The Republic of Kazakhstan has placed an order for two Airbus A400M aircraft and becomes the ninth operator together with Germany, France, United Kingdom, Spain, Turkey, Belgium, Malaysia and Luxembourg. With delivery of the first aircraft scheduled in 2024, the contract includes a complete suite of maintenance and training support. Together with the agreement a Memorandum of Understanding has also been signed to collaborate on Maintenance and Overhaul services and with a first step of creating a local C295 maintenance centre.

Updates from Saab

Saab delivers T-7A aft for the flight test programme

Saab has shipped its second aft airframe section, which is for use in the T-7A Red Hawk flight test programme. The production and shipment of this aft airframe section is the latest milestone in Saab's contribution to the design and development of the T-7A Red Hawk trainer for the United States Air Force. The shipment was from Saab's Linköping site in Sweden to Boeing in St. Louis, Missouri, USA. On completion of the Engineering and Manufacturing Development (EMD) production phase, Saab's brand new facility in West Lafayette, Indiana, USA will undertake Saab's production of the aft airframe sections for the T-7A programme.

Boeing will splice together Saab's aft section with the front section, wings, fins and tail assembly to become a complete test aircraft for use in the EMD's flight test programme. The aft section with installed subsystems - hydraulics, fuel and secondary power system - forms the center structure of the aircraft from behind the cockpit to the end of the aircraft.

In April 2021, Saab delivered its first T-7A Red Hawk aft airframe section for assembly as a ground-based structural testing aircraft. Upon arrival at Boeing in St. Louis, Saab's aft section was joined perfectly with the front fuselage in less than 30 minutes. That achievement is a "testament to the use of digital design and engineering, which delivers accuracy, efficiency and improved quality throughout the design and delivery of T-7A Red Hawk".

T-7A Red Hawk is an all-new, advanced pilot training system designed for the US Air Force to train the next generation of combat pilots for decades to come. The aircraft has benefited from Saab and Boeing's "breaking the norm" approach to military aircraft design, engineering and production, which saw the preceding T-X aircraft go from concept to first flight in just 36 months.

Carl-Gustaf ammo for the US

Saab has received an order for Carl-Gustaf ammunition from the US Army. The order value is approximately USD 75 million and deliveries will take place in 2022. The shoulder-fired ammunition order was placed within an Indefinite Delivery, Indefinite Quantity (IDIQ) framework agreement signed in 2019 between Saab and the US Army that allows the customer to place orders for Carl-Gustaf ammunition and the disposable AT4 shoulder-fired weapon systems during a five-year period. This order for the US Army and Marine Corps is comprised of seven different types of ammunition including anti-armour, anti-structure, smoke, and illumination rounds, all underlining the versatility of the multi-purpose Carl-Gustaf system.

Further order for the A26 submarine for Sweden

Saab has received a further order from the Swedish Defence Material Administration (FMV) to continue the development and production, as well as expand the capabilities, of the two A26 Blekinge class submarines previously ordered by Sweden. The order value is SEK 5.2 billion and the delivery of the two submarines will take place in 2027 and 2028. In June 2015, Sweden ordered the new A26 Blekinge class submarine, which is tailor-made for Swedish conditions. The capability to construct and build submarines places Sweden among the few countries in the world with the ability to develop advanced submarines.

News from Boeing

Boeing to support RAF Poseidon's for the next 5 years

Boeing and the UK Ministry of Defence have signed an agreement for Boeing to support the Royal Air Force's (RAF) fleet of Poseidon MRA1 maritime patrol aircraft and train the crews that operate them. Under the aircraft and training support contract, valued at $321.6 million (£233.5 million), Boeing will provide maintenance services, spares and repairs, including tools and ground support equipment, as well as supply chain management, forecasting and inventory management, and airworthiness services for the RAF's P-8 fleet.

Norway's 1st P-8A Poseidon in maiden flight

The first of five Boeing P-8A Poseidon aircraft for Norway performed its maiden flight on 9 August. The aircraft took off at 10:03 a.m. Pacific time and flew for 2 hours, 24 minutes, reaching a maximum altitude of 41,000 feet during the flight from Renton Municipal Airport to Boeing Field in Seattle. The first flight marks the next phase of the production cycle of this aircraft as it is moved to the Installation and Checkout facility, where mission systems will be installed and additional testing will take place before final delivery to the Norwegian Defence Materiel Agency (NDMA) later this year.

NAVSUP WSS team helps P-8A Poseidon meet FMC goals

In March 2021, Naval Supply Systems Command Weapon Systems Support's (NAVSUP WSS) P-8A Integrated Weapons Support Team (IWST) targeted 1 August as the deadline to achieve the goal of 56 Fully Mission Capable (FMC) P-8A Poseidon aircraft. With the assistance of government stakeholders and industry partners, the team reached the target ahead of schedule on 23 July. The P-8A IWST worked with each commercial vendor to ensure key components were prioritised and deliveries expedited. Engaging with commercial vendors to reduce Repair Turnaround Times (RTAT), developing firm delivery schedules through modifying contracts and developing relationships, contributed to accomplishing the FMC goal.

KC-46A for Japan completes first refueling flight

The first Boeing KC-46A tanker built for the Japan Air Self-Defense Force (JASDF) recently refueled another KC-46A aircraft in the skies over Washington state. The Japan-bound tanker also successfully received fuel in return. Japan is the KC-46 programmes first non-US customer and is scheduled to receive its first aircraft this year.

USN and Boeing in another MQ-25 first with E-2D refueling

The US Navy and Boeing have completed a second carrier-based aircraft unmanned refueling mission with the Boeing-owned MQ-25TM T1 test asset, this time refueling a Navy E-2D Hawkeye command and control aircraft. During a test flight from MidAmerica St. Louis Airport on 18 August, pilots from the Navy's Air Test and Evaluation Squadron VX-20 conducted a successful wake survey behind MQ-25 T1 to ensure performance and stability before making contact with T1's aerial refueling drogue. The E-2D received fuel from T1's aerial refueling store during the flight.

Boeing unveils F-15 Qatar advanced jets

Boeing, in collaboration with the US Air Force and Qatar Emiri Air Force (QEAF), have celebrated the naming and rollout of Qatar's advanced F-15, the F-15QA. The first set of F-15QA jets will ferry to Qatar later this year following the completion of pre-delivery pilot training. Boeing has been providing maintenance and logistics support for the QEAF during pre-delivery pilot training, which began earlier this year. In addition, Boeing will establish and operate an aircrew and maintenance training centre for the QEAF at Al Udeid Air Base in Qatar through 2024 while also providing in-country spares and logistics support once aircraft are delivered.

Dassault delivers first Rafale to Greece

Eric Trappier, Chairman and CEO of Dassault Aviation, hosted the ceremony of the delivery of the first Rafale for the Hellenic Air Force (HAF) at the Dassault Aviation Flight Test Centre in Istres, in the presence of Nikolaos Panagiotopoulos, Greek Minister of National Defence on 21 July 2021. This first delivery comes after six months following the signature of the contract for the acquisition of 18 Rafales. This first aircraft, as well as the next five to come from the French Space and Air Force, will train the HAF Pilots and Technicians in France before deploying to Tanagra Air Force Base. A first group of HAF pilots, already trained for several months by the French Space and Air Force, and 50 HAF technicians will join the Dassault Aviation Conversion Training Centre (CTC) in Mérignac, France to continue their training. The Rafales will provide the HAF with a "latest-generation multirole fighter, enabling the Hellenic Republic to ensure its geostrategic stance in full sovereignty". The delivery of the first Rafale is a "clear demonstration of France's determination

to meet the government of the Hellenic Republic expectations and to participate actively to the sovereignty of the country. It illustrates also Dassault Aviation's outstanding quality of the cooperation with the Hellenic Air Force, through more than 45 years of uninterrupted and strong partnership".

"Following the Mirage F1 in 1974, the Mirage 2000 in 1985 and the Mirage

2000-5 in 2000, the Rafale is now proudly flying with the Hellenic Air Force colours. The Rafale is a strategic game changer for the HAF. It will play an active role by securing Greece's leadership as a major regional power. I would like to reaffirm our total commitment to the success of the Rafale in Greece," stated Eric Trappier, Chairman and CEO of Dassault Aviation.

Dassault Aviation Group 2021 half year results

The Board of Directors met under the chairmanship of Mr. Éric Trappier and approved the 2021 half year financial statements. "The 1st half of 2021 saw contracts for the Rafale Export and Rafale France, the Falcon 6X maiden flight, the resumption of Falcon orders, the Falcon 10X reveal and its first orders. In the military aircraft segment, the year began with the sale to Greece of 18 Rafales (6 new and 12 pre-owned aircraft currently in service with the French military), followed by the sale to France of 12 additional Rafale to replace the 12 pre-owned aircraft sold to Greece, bringing the total Rafale France ordered up to 192. Egypt also signed a contract to purchase an additional 30 Rafales, bringing the number of Rafale in service in the Egyptian Air Force to 54. Croatia announced that it had selected the Rafale with a view to acquiring 12 pre-owned aircraft from France.

Other highlights included:

Active discussions and negotiations for the FCAS continued during the 1st half of 2021: the Joint Concept Study (JCS) launched in January 2019 is nearing completion.

Launched in February 2020, phase 1A of the FCAS demonstrators, and the New Generation Fighter in particular, is continuing. The focus is on aerodynamics, with the first wind tunnel tests scheduled for September 2021.

The contract for phase 1B (under negotiation) is still to be signed. This will cover all the work carried out jointly between France, Germany and Spain until 2024 (NGF demonstrator studies, for which Dassault Aviation is the prime contractor).

The contract for the Eurodrone, a medium-altitude, long-endurance drone, between the OCCAR (Organisation for Joint Armament Cooperation) and Airbus Defence and Space (the prime contractor) has been negotiated. Notification is expected in 2nd half 2021.

During the 1st half of the year, we delivered 13 Rafale Export (India and Qatar) and continued to support the French and Export fleets.

We delivered 6 Falcon during the 1st half of the year and booked 25 new aircraft orders (vs. 16 deliveries and 5 orders in 1st half 2020).

The 2021 guidance remains unchanged, ie, delivery of 25 new Rafales and 25 new Falcons.

Courtesy: Dassault

Tempest funding set to advance the UK's future Combat Air capability

The UK Ministry of Defence (MOD) has awarded a contract worth approximately £250m to progress the design and development of Tempest, the UK's Future Combat Air System (FCAS). The contract, signed by BAE Systems, officially marks the start of the programme's concept and assessment phase.

Continued funding of Tempest underlines the UK Government's confidence in the progress and maturity of the programme, which is set to deliver the military, industrial and economic requirements of the national combat air strategy.

The programme is being delivered by Team Tempest – combining the expertise of the UK MOD, BAE Systems, Leonardo UK, MBDA UK and Rolls-Royce. Working with international partners, the team is leading progress towards a UK-led internationally collaborative Future Combat Air System which will ensure the Royal Air Force and its allies retain world-leading, independent military capability.

The concept and assessment phase contract will see the partners develop a range of digital concepts, embedding new tools and techniques to design, evaluate and shape the final design and capability requirements of Tempest.

Announcing the contract during a visit to BAE Systems' Warton site in Lancashire, Ben Wallace, UK Secretary of State for Defence stated, "Today marks a momentous step in the next phase of our Future Combat Air System, with a multi-million pound investment that draws on the knowledge and skills of our UK industry experts. Boosting our already world-leading air industry, the contract will sustain thousands of jobs across the UK and will ensure that the UK remains at the top table when it comes to combat air."

Chris Boardman, Group Managing Director of BAE Systems' Air Sector, added, "Working with our industry partners and the Ministry of Defence, we are on track to deliver an ambitious programme for the UK, which will provide a highly advanced and sophisticated air defence capability, capable of countering future threats and safeguarding our national security and defence. The funding announced marks a critical next step for the programme and, with our partners, we will work together to define the technical and capability requirements and develop the concept which will bring Tempest to life.

Tempest will pioneer cutting-edge technologies, including those assisted by Artificial Intelligence, machine learning and autonomous systems to meet the capability requirements of future conflicts and be operational in the mid-2030s. The design and production of Tempest demands a radically different approach and the Team Tempest partners are working with companies in their supply chain to drive digital transformation, embedding a digital enterprise through the ecosystem; embracing an agile approach that will deliver a combination of advanced technologies, efficiency, speed of production and lower costs.

Recent research conducted by PwC underlines how the Tempest programme is expected to deliver significant and wide ranging benefits to all regions of the UK, stimulating vital investment, productivity, skills and innovation. The programme will make an estimated £26.2bn contribution to the UK economy, create high productivity employment - 78% higher than the UK national average – and will support an average of 21,000 jobs a year.

(All images: BAE Systems)

Exercise Atlantic Trident

17-28 May 2021 at BA Mont-de-Marsan, France

Introduction

The Atlantic Trident exercise took place in France and in Europe for the first time from 17 to 28 May 2021 at Mont-de-Marsan Air Force Base. This exercise, organised by the French Air Forces Command provided the opportunity for the US Air Force, the UK Royal Air Force and the French Air and Space Force to operate and learn together. This triumvirate sits within a select group of Air Forces in the world capable of conducting all types of conventional air operations. With the most performant fighters in the world, the three air forces are part of the only nations able to activate a joint air force, which is capable of conducting high intensity missions behind enemy lines, without delay.

Sixty aircraft were involved – amongt them 50 fighters. Assets such as the KC-135 (FR, US) and the A330 tanker aircraft (FR, UK), and the E-3D Sentry (UK), E3-F (FR) aircraft accompanied them. Together, they participated in complex and realistic missions, facing the current challenges both of digitized airspaces and of the evolution of the global strategic context and enemy defences.

The Exercise and its issues

The Atlantic Trident exercise was born from a strategic partnership known as the Trilateral Strategic Initiative (TSI), concluded between the American, British and French Air Forces in 2010. The first two editions took place in Langley, Virginia in 2015 and 2017. Mont-de-Marsan AFB is a key French operational base, at the forefront of France's capabilities in air combat, surface-to-air defence and innovation. As such, it was the ideal platform to host the third edition of this exercise. Halfway between a technological showcase and an operational challenge, this high-level exercise aimed to test and improve the interoperability of the three Air Forces and to strengthen the technical and tactical knowledge they have of one-another.

They plan, develop and conduct combined raids, in opposition to an enemy force (Red Force) made up of Mirage 2000, Alphajet or French Rafale. To face the future threats, they got ready together to conduct high intensity combat; the goal requiring an optimal integration between each of these latest generation fighters. For the purpose of this exercise, a fictitious scenario was established. The Blue Force must therefore fulfil repeated attacks from the Red Force by air defence missions called Defence Counter Air (DCA) to protect an area or a territory. The final objective was to obtain air supremacy in order to be able

to neutralise the enemy threat by offensive in-depth air raids behind the battle lines.

The morning's first round was devoted to a "Main Wave" with COMAO-type missions (Composite Air Operations). These huge missions featured simulated battles using all aircraft, which had distinct roles. Afternoons were dedicated to less complex missions with reduced participants called "Shadow Waves". The different squadrons competed on various scenarios, in which the Airmen and their allies were allies or aggressors alternatively. At the head of these missions, pilots took turns to ensure the Mission Commander function, a leader of the air raid. From the operational command, an Airboss was going to host the scenarios thanks to a visualizstion of the tactical air situation in real time.

Presentation of "lead" units

The Rafale of the 30e Escadre de Chasse: The 30e Escadre de Chasse has been located at Mont de Marsan AFB since 2015. This unit is made up of 800 aviators and is outstanding due to its diverse range of missions and concurrent commitments. Its Rafale aircraft are currently engaged in the Middle East as part of the 'Chammal' operation and in the French area for the air policing missions (permanent air safety posture) but also participates in major exercises in France or abroad. The 30th Fighter Wing includes operational, maintenance, management and experimentation squadrons.

The sharp end of the 30th Fighter Wing is the F3-R Rafale, which was on the front line of the Atlantic Trident exercise. With its array of technical improvements, the F3-R Rafale standard is a real revolution. Integration of the Meteor air-to-air long-range missile, Talios laser designation pod increasing detection and identification target capabilities or even air-to-ground optimised weaponry. These new capabilities increase the multi-functionality of this state-of-the art fighter. They allow it to carry out all the missions that may be entrusted to the French Air and Space Force, that is to say the airborne component of nuclear deterrence, air defence, in-the-depth strike at any time or support to on the ground troops. 102 two-seater Rafale B and single-seater Rafale C are currently being operated in the French Air and Space Force. The target at 129 Rafale provided for by the military planning law for 2025 is a key issue in order to have a critical mass of necessary aircraft to carry out all of the Air Force missions.

388th Fighter Wing and USAF F-35: The primary mission of the 388th Fighter Wing is to maintain combat readiness to deploy, employ, and sustain F-35A Lightning II aircraft worldwide in support of the national defence. The 388th FW is assigned to Air Combat Command, Joint Base Langley-Eustis, Virginia, and below that, Fifteenth Air Force, Shaw Air Force Base, S.C. ACC's mission is to provide a combat air force among the best in the world, delivering rapid, decisive air power, anytime, anywhere. There are approximately 2,000 airmen and civilian professionals assigned to the 388th FW. The wing employs 78 F-35A Lightning IIs, the Air Force's most advanced multi-role fighter aircraft. The F-35A Lightning II is the US Air Force's latest fifth generation fighter. It will replace the US Air Force's aging fleet of F-16 Fighting Falcons and A-10 Thunderbolt II's, which have been the primary fighter aircraft for more than 20 years, and bring with it an enhanced capability to survive in the advanced threat environment in which it was designed to operate. With its aerodynamic performance and advanced integrated avionics, the F-35A will provide next-generation stealth, enhanced situational awareness, and reduced vulnerability for the United States and allied nations. The F-35B Lightning II is the Marine Corps variant of the Joint Strike Fighter and features a vertical lift fan and pivoting engine nozzle to deliver vertical landing and short takeoff capability to expeditionary airfields. The F-35 will replace AV-8B Harrier IIs in the Marine Corps inventory.

Means employed

From Mont-de-Marsan airbase 118

- 8 Rafale, 30ème escadre de chasse (Mont-de-Marsan)
- 4 Rafale, 4e escadre de chasse (Saint-Dizier)
- 12 F-35 A Lightning, 388th Fighter Wing (USAF - Hill Air Force Base)

From HMS Queen Elizabeth (Royal Air Force)

- 4 F-35 B Lightning, 617 (Dambusters) Squadron (RAF)
- 4 F-35 B Lightning, United States Marine Corps Aviation (USAF) F

From their home airbase

- 4 Typhoon, XI Squadron (RAF Coningsby AB - Great Britain)
- 2 KC 135 , 100 ARW (RAF Mildenhall - Great Britain)
- 2 KC-30 Voyager, 10 & 101 (RAF Brize Norton - Great Britain)
- 1 Phénix ou 1 C135, groupe de ravitaillement en vol (Istres)
- 1 E-3F, escadron de détection et de contrôle aéroporté (Avord)
- 1 E3-D, VIII Squadron (RAF Waddington - Great Britain)
- 2 Mirage 2000D, 3e escadre de chasse (Nancy)
- 4 Mirage 2000-5, 2e escadre de chasse (Luxeuil) Î
- 2 Mirage 2000 RDI, escadron de chasse 2/5 (Orange)
- 4 Alphajet, 8e escadre de chasse (Cazaux)
- 2 Pilatus PC-21, école de pilotage de l'armée de l'air (Cognac)
- 4 Rafale Marine, flotille 12F (BAN de Landivisiau)
- 2 Caracal, escadron d'hélicoptères 1/67 (Cazaux)
- 1 A400M Atlas, escadron de transport 1/61 (Orléans)
- 2 C130, 62e escadre de transport (Orléans)

Control units

- Escadron des services de la circulation aérienne de Mont-de-Marsan
- Centre de détection et de contrôle de Mont-de-Marsan et Cinq-Mars-La-Pile
- Centres militaires de coordination et de contrôle
- Centre de détection et de contrôle déployable, escadron de détection et de contrôle mobile

Jamming communications

- SCRIBE, escadron électronique sol (Orléans)

British Royal Air Force F-35 and Typhoon: Royal Air Force assets involved in the war fighting element of the exercise include Typhoons from XI (F) Squadron normally based on Coningsby and significantly, F35Bs flying off the UK's new Aircraft Carrier, HMS Queen Elizabeth. The Carrier is at the heart of Carrier Strike Group 21 which was in waters off France at the time of the exercise. The RAF F35 Lightning Jets flying from the Carrier are flown by 617 (Dambusters) Squadron which is the first fighter unit to undertake an operational Carrier Strike deployment since 2010. Lightning is a multi-role machine capable of conducting missions including air-to-surface, electronic warfare, intelligence gathering and air-to-air simultaneously. The plane combines cutting edge sensors and mission systems with stealth technology which enables it to operate undetected in hostile airspace. The UK's and USMC F-35B is of course a short take-off and vertical landing (STOVL) fighter jet; the world's first supersonic STOVL aircraft and as well as flying from the new QE Class carriers, the UK plane has the ability to operate from land bases and remote locations, providing versatility that will revolutionise the UK's expeditionary combat power.

A rich tactical environment

A prime training area, offers many advantages in terms of the Marsan) quality and realism of major Air Force exercises: 3600 metres major aeronautical platform - runway, capacity for large aircraft (tactical or strategic transport aircrafts), modern and colocated control units, etc; location of the 30th and its Fighter Wing Rafale; (direct access to the very adapted airspaces - low altitude network, proximity to Captieux shooting range, maritime and mountainous areas, combat aeras nearby). Designed to cover a wide range of skills in order to meet many operational preparation objectives, Exercise Atlantic Trident took place mainly in (Massif Central, Southwest three training areas of France).

Some squadrons participated in air missions from their home bases, a format which has become common practice for the Atlantic Trident exercise and made possible by the implementation of "Airboss". Joint briefings/debriefings were enhanced by the presence of collaborative tools provided by the Mont-de-Marsan Air Expertise Centre,

acting like a true air combat referee in charge of organising the various fights and engagements in the area. Throughout the exercise, the use of Link 16 is common.

Distributed mission operations centre

Created in 2018 under the name DMOC "Distributed Mission Operations Center", the Centre Expert du Combat Collaboratif (CECC) provides a range of high value-added services of support the daily operational readiness to the forces. The deployment of the LVC16 "Live Virtual Constructive Link 16", an innovative tool called "Jeannette", which is considered as the heart of this centre, provides to front-line forces and air operation crews the ability to create complex training scenarios, animation, simulation and capitalisation of lessons during training slots in France. These services are delivered both to the benefit of the "Live" and in the future to distributed simulation federations "Virtual".

High-tech collaborative tools

Atlantic Trident is enabled by the use of 'TacView' collaborative tools with many crews operating from software their home air base. Indeed, this specific interconnected software allows the rendering and debriefing of missions by videoconferencing. Inspired by civil software from the world of video games, it allows pilots to debrief their training sessions by screening all actions performed. 'TacView' renders all their actions and

trajectories in three dimensions. They are shared with all participants simultaneously by network with commentary by the mission's 'Airboss'. The latter, coordinator and animator of the air missions, plays the manager role. During the mission, he is located in a dedicated room. Thus, he can use the 'Jeannette' software suite the follow the actions of the various participants in real time. The software receives and merges on a single screen the radar tracks and those related to the link 16. 'Jeannette' also combines real and simulated resources by joining aircraft in flight and virtual runways. With the help of range Training Officers, he leads the mission in real time for friendly or enemy forces. These collaborative tools connect all the players on COMAO missions. They allow crews to have/make the replay as efficient as possible a common vision, exchange


© Anthony JEULAND / armée de l'Air et de l'Espace


5264

and debrief in order to gain in realism and leads to a highly beneficial exercise. These revolutionary programmes have the added extra benefit to the advanced training. These technological developments have the advantage to make aircraft delocalisation possible, thus ensuring a considerable logistical and economic gain.

Text: Armée de l'Air et Espace
Translation: Joris van Boven and Alex van Noije

Photo credits:

US Air Force photos of F-35s:_USAF Staff Sgt. Alexander Cook, 39th Air Base Wing Public Affairs

USMC photos on deck of the Queen Elisabeth II: USMC Lt Zachary Bodner

USMC F-35s photos air-air (from a RAF A330 Voyager): Royal Air Force Corporal Cathy Sharples, RAF Media Reserves, courtesy of 3 Marine Air Wing

Armee de l'Air photos have the copyright in the photos: Antony Jeuland, Emma le Rouzic

Airbus A330 MRTT number 5 lands at Eindhoven Air Base

The fifth Airbus A330 MRTT registered in the Netherlands landed at Eindhoven Air Base on 31 August. Six European countries have jointly ordered nine of these aircraft.

Of the nine A330s, five have Eindhoven AB (NL) as their Main Operating Base (MOB), the other four go to Cologne AB (DE) as Forward Operating Base (FOB). The aircraft are owned by six countries: Belgium, Germany, Luxembourg, the Netherlands, Norway and the Czech Republic and are operated by the Multinational MRTT Unit (MMU) consortium. They should all be delivered by 2024. Initially 8 were ordered and in 2020 Luxembourg contributed for the 9th A330 MRTT aircraft.

The A330 MRTT can accommodate 267 passengers and 45 tons of cargo. In addition, the aircraft can be converted in a short time into a flying infirmary with 6 intensive care units and 16 stretchers for the transport of wounded from a war or mission area. The Netherlands is allowed to use the A330s for a total of 2,000 hours per year. Germany is a major user with 5,500 hours, Belgium has 1,000 hours available.

The A330 MRTT will replace the KDC-10 fleet of the Dutch Air Force.

Text and photos: Joris van Boven and Alex van Noije

Exercise Anatolian Eagle 2021

International Anatolian Eagle-2021 Training was held in Konya (Turkey) between 21 June-2 July under the 3rd Main Jet Base Command. Among the firsts observed during the training, red stickers were affixed to the horizontal and vertical tail surfaces of F-16 aircraft playing the role of enemies. MSI Turkish Defence Review team attended the Distinguished Observer's Day of the training held on 30 June.

Azerbaijan, Pakistan and Qatar Air Force and NATO AWACS units also participated in the training in addition to the Turkish Air Force and Navy units. In addition, participants from Bangladesh, Belarus, Bulgaria, Burkina Faso, Georgia, Hungary, Jordan, Iraq, Japan, Kosovo, Lebanon, Malaysia, Nigeria, Oman, Romania, Sweden, Tunisia and Ukraine participated in the training as observers.

The training was mainly carried out in Anatolian Eagle airspace in a generic scenario where the operation environment from simple to difficult was simulated. The objectives of the training are as follows:

Units that participated at Anatolian Eagle 2021

Country/Force	Units
Turkish Air Force Command	39 x F-16 1 x E-7T 2 x KC-135R 1 x ANKA-S
Turkish Naval Forces Command	2 x frigates 2 x fast patrol boats
Azerbaijan	2 x Su-25 2 x MiG-29
Qatar	4 x Rafale
NATO	1 x E-3A
Pakistan	5 x JF-17

- To increase the operational training level of the pilots and air defence personnel in a most realistic operational environment.
- To exercise and develop joined and combined operational procedures.
- To decrease the attritions to a minimum level and to increase mission effectiveness to a maximum level in real operation environment.
- Give a chance to fighter pilots to execute their planned tactics in large force compositions.
- Provide a forum to exchange ideas and lessons learned.
- Train the participants as they fight and teach them how to survive.

A total of 57 aircraft and 537 personnel served during the training. The number of sorties flown was 450.

Firsts of this Year

The training was also the scene of important firsts this year.

During the training, the certification assessment of Turkey's capabilities, committed to the NATO Response Force (NRF) was performed for the first time. The Combat Readiness and interoperability capability of the 6 F-16 aircraft, 1 KC-135R aircraft and 6 Stinger air defence teams, committed by the Turkish Air Force to the Very High Readiness Joint Task Force within the scope of NRF, was supervised by NATO and Turkish authorities.

Another first was when Azerbaijan joined the Anatolian Eagle for the first time. The shooting of a target with laser marking by the F-16 aircraft of the Turkish Air Force

by the Su-25 aircraft of the Azerbaijani Air Force was one of the most important indicators of the contribution of the exercise to the joint operation during the training. The fact that the weapon used by Su-25 was QFAB-250 LG guided bomb developed jointly by ASELSAN and the Azerbaijani Ministry of Defence further increased the value of this exercise.

Red F-16s on the Stage

One of the first introduced in training was the performance of F-16s with red stickers on horizontal and vertical tail surfaces. These F-16s were aircraft attached to the 132nd Dagger (Hancer Filo) Squadron, playing the role of enemies in training.

HAVELSAN EHTES at Work

Electronic Warfare Testing and Training Field (EHTES) developed by HAVELSAN was also used in the training. A number of operational scenarios were performed at EHTES, which provides electronic warfare training for pilots and aircraft in a fully instrumented and near-real threat environment. EHTES is being used by the Turkish Air Force as well as the Republic of Korea and Pakistan.

National Combat Aircraft Briefing to Allied Countries

A number of details about the Turkish National Combat Aircraft (TF-X) were also shared with the participants during the press briefing held on the Distinguished Observer's Day.

TF-X is planned to remain in the inventory until the 2070s according to the information provided. ASELSAN (radar and electro-optic systems), TÜBİTAK-BİLGEM (integrated processing unit), and BAE Systems (cooperation partner) were named as the main subcontractors as well as the main contractor of the project, Turkish Aerospace, in the briefing.

The preliminary design review meeting of the project is scheduled for September, 2022. Thereafter, the detailed design and qualification phase, which will last until the end of 2029, will begin. 3 planes are planned to be used at this stage. It is aimed to supply more than 10 Block 1 TFXs in the first stage at the beginning of the 2030s. It is planned to supply more aircraft in the consequent blocks in the following years.

The critical capabilities of TF-X are: Improved aerodynamics and propulsion; Ability to reach supersonic speed without afterburner; Adequate and optimised operation radius; Advanced and internal multi-spectrum sensors

(radio frequency, infrared, electronic warfare); Low observability; Sensor fusion and autonomy; Advanced data link for networked combat and Precision and long-range weapons.

The aircraft will have a design in which a range of performance criteria are optimised to have each of these capabilities. This means that the aircraft cannot be the best in its class in some parameters. Examples were given in the briefing. For example, it is predicted that the operating radius of the aircraft will be better than that of the 4th and 4.5th generations; it will be slightly lower than that of the 5th generation. Its maximum speed will be slightly lower than that of 5th generation aircraft with TF-X's ability to reach supersonic speed without afterburner.

The TF-X will have an integrated infrared search and track sensor. In addition, infrared surveillance and missile warning system will be part of the aircraft's equipment in a 360-degree coverage area, day and night.

The TF-X is projected to have an integrated gun. The weapons and other systems that the aircraft can carry at the internal and external hard points are listed as (expressions in brackets are examples given in the briefing): Ramjet engine, long range air-to-air missiles (like METEOR); Solid engine long range air-to-air missiles (GÖKDOĞAN); Short range air-to-air missiles (BOZDOĞAN); Mini cruise missile (like SPEAR); SOM B1/B2/J; HGK-82/83/84; KGK-82/83; LGK-82/84; TEBER-82/83; Penetrator Bomb (NEB); Miniature Bomb; AKBABA (Vulture) missile; GBU-10/12/24/31/38/54; MK-

platforms participated and around 24,000 sorties were flown in these trainings. Up to this year, 15 countries participated in AE Trainings.

The AE Training is not only an important step taken in meeting the training requirements of Turkey, allies and friendly countries but also taking the initiative to contribute the international reliance and cooperation by sharing the resources it possesses, gifted by its unique geographic situation.

Text and photos: Onur Kurc & Tayfun Yaşar

82/83; Reconnaissance pod; 600 gallon fuel tank and 370 gallon fuel tank.

The information that TF-X can carry a load of 1,000 lb (approximately 450 kg) at the internal weapons bay was also shared in the briefing.

Anatolian Eagle Training

Anatolian Eagle (AE) Training Centre, located in the 3rd Main Jet Base, Konya, is a high level tactical training centre, providing realistic combat training opportunities to Turkish Air Force's wings and friendly countries in a high threat environment, more sophisticated than the unit level trainings on aspects such as the size of airspace, tactical ranges, threat emitters and number of participants. The AE airspace, 120 nm-216 nm wide long, allows to more than 60 assets to employ their tactics away from the effects of any traffics around.

Since its establishment in 2001, 43 AE Trainings have been performed. More than 33,000 personnel and 2,000 air


TURKISH AIR FORCE

Défilé 2021, Paris

Every year, on 14 July, the annual Bastille Parade takes place at the 'Avenue des Champs-Élysées' in the centre of Paris. Soldiers march and tanks drive in tight formations in the streets of Paris, while overhead can be seen formations of aircraft and helicopters, led by the 'Patrouille de France' showing the French colors Blue, White and Red.

In the weeks before the 14th, the preparation flights started at Base Aerienne (BA) Orleans with the various section leads. Later the final preparations were performed overhead the city of Paris, for fine tuning.

On 14 July, aircraft and helicopters took off from various bases near Paris and from their homebases France. The Marine Nationale aircraft flew from their homebases Base Aerienne Navale (BAN) Landivisiau (with Rafales) and BAN Lann-Bihoue (with Atlantic, E-2 Hawkeye, Falcon 50M). The larger Armee de l'Air aircraft also flew from their homebases (E-3F from temporary airport Châteauroux, due to reconstructions at BA Avord; A400M from BA Orleans; A330 MRTT from BA Istres). The Rafale fighters from BA St-Dizier also flew from their homebase. Smaller aircraft like the AlphaJets (the Patrouille de France) and the PC-21 flew from BA Villacoublay. Armee de l'Air and Marine helicopters flew from BA Villacoublay and Armee de Terre helicopters flew in from the military academy terrain of St-Cyr-l'Ecole, west of Paris.

BA Evreux

But all the other French fighters used BA Evreux (some 90 kilometers from Paris) as their take-off base. This year Rafales from BA Mont-de-Marsan, Mirages 2000D from BA Nancy, Mirages 2000C from BA Luxeuil and BA Orange took off from BA Evreux. In the early morning, some 20+ fighters started their engines for the takeoff. Special guests this year were the DGA delegation and the new Beech 350 surveillance aircraft while local based CASA CN-235s were the first to take off from BA Evreux.

DGA

La Direction Générale de l'Armement (DGA, Directorate General of Armaments) is the French Government Defence procurement and technology agency responsible for project management, development and purchase of weapon systems for the French Armed Forces. It has a section dedicated to military flying assets that was formerly known as CEV (Centre d'Essais en Vol). After the closure of the Brétigny AB, the DGA moved to BA Cazaux and BA Istres. DGA uses a set of AlphaJets, Mirage 2000 C/D/N, PC7, Fennec, Dauphin and Puma's. For the 2021 Defile, the DGA sent two Mirage 2000s and 3 AlphaJets to BA Evreux. One Mirage 2000 and two AlphaJets took off, while one Mirage 2000 and one AlphaJet remained as ground-spares.

St-Cyr-l'Ecole

The helicopters of the Armée de Terre (Aviation Légère de l'Armée de Terre, ALAT) normally fly their Defile from the former airbase of Creil, north of Paris. But in 2021, the helicopters were based at the military academy terrain of St-Cyr-l'Ecole, west of Paris. After the Defile, the ALAT helicopters were refueled at the academy, with the nearby aerodrome St-Cyr-l'Ecole as a backup location. Several ALAT helicopters flew via the aerodrome to the academy terrain and returned to their homebase afterwards.

Text: Joris van Boven and Alex van Noye
Photos: Armée de l'Air


115 OR
ARMEE DE L'AIR

Air Marshal Harish Masand (R) says...

I learnt more than flying from them

Homi Mistry

Homi in the Tiger Moth

Even though I was doing engineering in the lone engineering college of Indore, Govindram Seksaria Technical Institute or GSTI as it was known those days, I had joined the NCC Air Wing, then 16 (MP) Air Squadron, in Indore even before admissions to the College had been announced and the session commenced in July 1963 after I had completed Higher Secondary in April 1963. This was the unit that my elder brother, MG "Sonny" Masand, had left the year before as a Senior Under Officer. Because of this, the then CO of the NCC unit, Squadron leader AN Todd, had no reservations in letting me join the unit particularly after he saw my academic reports of the previous years. In that summer break, being keen on aeroplanes and flying, I got involved in aero-modelling with the help of JWO Karunakaran and Sergeant Ghoshal who let me have free access to the aero-modelling section and flying the ones I had built in the adjacent Holkar College grounds that the unit used for its aero-modelling activities. By the time summer ended and the academic session started, Squadron leader MS Rane took over the NCC Air Wing Unit from Todd. Sometime in 1964, the unit nomenclature also changed to 1 (MP) Air squadron NCC from 16 (MP).

NCC those days was mandatory for all college-going students so all colleges had an appropriate NCC unit attached to them. The GSTI had its own Engineers NCC unit that I was required to join. However, due to the fact that I had already enrolled in the Air Wing, the Principal of the college, Mr Dasgupta, gave me a special dispensation, after an interview and looking at my grades, by letting me continue with the Air Wing unit on the proviso that if I missed any classes or assignments in the college due to different timings for the NCC activities, I would submit the required assignments the very next morning. I never missed out on that commitment and looking at my grades in the engineering college, Mr Dasgupta never had an issue with my NCC and other activities. What he said to me when I left the course halfway through in early 1966 to join the Air Force through the NCC after getting my "C Certificate" is another matter. When I went to say Good Bye, he was quite surprised, told me I was making a mistake and ended by saying, "I always thought you were a smart kid, Now I know you are an a—h—".

Anyhow, coming back to my flying activities, those days NCC Air Wing sponsored a few selected cadets for 50 hours of flying through the nearest flying club after they had cleared the requisite ground subjects and "B Certificate" with two years training. In our case, the Flying Club was at

Homi in the mid-1960s

Homi and Alma in the 1960s

Indore itself with Mr Bhojwani as the Chief Pilot Instructor (CPI). However, the man who really taught me the initial bits of flying and laid a solid foundation for my future career was the Assistant Pilot Instructor (API), Homi Mistry. So come early July 1965, Sqn Ldr Rane took a few of us across to the flying club and handed us over to our instructors. I was very fortunate to land up with Homi Mistry since he did not just teach me the basics of flying on the iconic Tiger Moth but even the art of dealing with pupils and subordinates.

Homi himself was not very old, just about 10 years older than all of us and had been an instructor in Indore for about five years by then. He looked like a twin of Omar Sharif with a similar style, charm and smile. That made him extremely popular with the younger cadets and students, both from the NCC and the civilians trying to make a career in aviation and, perhaps, even with the opposite sex. However, by the time I reached the aviation scene and met him, he was already happily married to Alma, who everyone considered their "ally" in the Mistry household, as I would describe later. Civilian instructors were not known for their pre-flight briefings or much time spent with the students on what was expected of them that day or in that particular flight. However, in our very first meeting, Homi spent a few minutes explaining the Tiger Moth to us and what he would demonstrate in the very first air experience flight. He also asked a few questions on aerodynamics and piston engines just to satisfy himself that we knew our theory. When he realised that I was an engineering student in the third year of my course, he did not bother much with the theory any further but told me specifics of the propeller torque on the Tiger Moth and things like the use of rudder on take-off when the nose was lowered while building up speed. After explaining the basic controls and our means of communications through just the voice-tube, he told me that if I knew how to drive a car smoothly, which ran in two dimensions on the surface, I would have little problem in learning to control the aircraft in three dimensions.

My very first ride in the Tiger was an exhilarating experience in July 1965 which I have not forgotten till date. Homi made sure I was correctly strapped up in the rear cockpit, got into the front cockpit, carried out a voice check and started the engine

Homi with the Tiger Model VT-HRM, September 2021

with the help of a technician cranking the engine through a flip to the propeller. The smell of smoke and avgas once the engine caught on was also unforgettable. Those days, and rightly for the Tiger, we operated from a grass strip and dispersal because of the tail skid which tended to break on hard concrete surfaces. The small concrete dispersal was generally used for parking of a few Pushpak aircraft of the Flying Club. The feeling when we taxied out was almost like being in a First World War movie with our leather helmets and goggles. Perhaps, the only thing missing was Snoopy's scarf flying in the wind out of the cockpit. However, to have something like that in my clothing may have been too presumptuous or arrogant at that stage of training. We rolled down the runway for take-off on a green flag signal from the tower and were soon airborne with me lightly following Homi on the controls and correlating his control movements with the attitude of the aircraft in the stages of climb and level flight to about 1000 feet. Homi demonstrated a turn to each side shouting out the coordinated movement of stick and rudder required for a balanced smooth turn and then suddenly asked me to try some turns. I think I did okay since soon Homi was showing me and asking me to do a climb and descent with some turns. Unfortunately, the most enjoyable experience of this flight came to a very rapid end since we were soon on circuit where Homi displayed a circuit and landing with a roller and then asked me to do some while gently guiding and correcting me through the circuit. I don't really know whether he actually did the landing but he certainly made me feel that I was doing it on my own with him monitoring it. Soon, in the next few flights, Homi was letting me perform most of these manoeuvres myself with some gentle instructions and nudging to perform them well and kept building up my confidence. Even on the ground after the morning's flying or when he got out after two or three instructional trips for the aircraft to be refuelled, he spent a little more time than expected debriefing me on the errors I had made and corrective measures. Sqn Ldr Rane was also always on hand on the ground after our flying to collectively check with us on what we had learned that day and steps to improve our control of the aircraft before we broke up for the day.

Homi is the one who built my foundations in aviation correctly. For example, he showed and told me to hold an attitude that felt correct with the chosen engine setting for that particular condition of flight without worrying about the speed or the height, trim and wait to see whether the aircraft would settle down at the correct speed/height. All this while, I could look around and do other things. Once the aircraft settled down, he taught me to change the attitude just a bit, if required, hold, trim and wait again. Later, with more experience, I developed this further on my own to tailor this technique for fighter flying by smooth movements of the controls without chasing the instruments

Representational photo of the Tiger Moth (Photo by Alec Wilson*/commons)*

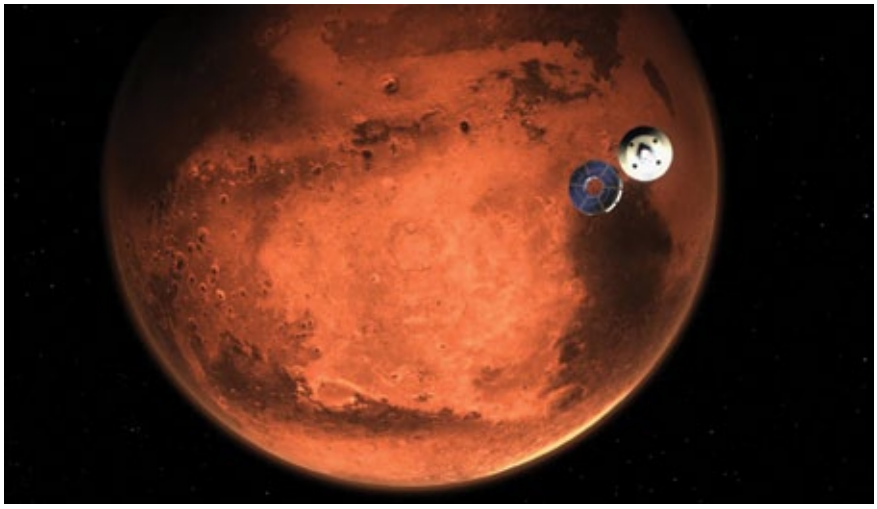
thus getting a lot of time to do all the other things one needed to focus on for fighter flying. Without being a fighter pilot, Homi demonstrated this technique of flying by the "Seat of the pants" that many fighter pilots that I flew with later either did not know or did not follow. Later in the Air Force, I taught this technique to all my pupils and subordinates when I flew with them. By the fourth sortie, Homi was showing me dives and climbing turns over the nearest lake, Yeshwant Sagar, as if we were in an attack against some imaginary surface target or just beating up a boat. Around this time, he also told me that I was ready to go solo. Unfortunately, Indore airfield was then going under surfacing works to build it up for regular aircraft and civil flights instead of the grass strip good only for flying club activities. Concurrently, the CPI, Mr Bhojwani, did not seem too fond of NCC cadets, and particularly me perhaps, and though I was taken for a check ride with him soon after, he decided that no solos would be permitted and I just got a total of about 10 dual trips on the Tiger instead of the 50 hours before Sqn Ldr Rane decided to divide the available flying effort and give more number of cadets the experience instead of wasting 50 hours of dual flying on a limited number of cadets. Soon after, I also went out of Indore for the NCC Commonwealth Camp in Singapore in August 1965 which, with the selection and debrief process, kept me away for almost a month. This was followed by a call from the Services Section Board (SSB) at Dehradun for the Air Force. My pre-IAF flying thus ended with just those few but most enjoyable flights in the open cockpit of the Tiger Moth.

Perhaps, as importantly, Homi taught me about personal relationships and the caring attitude for pupils to nurture them slowly, based on individual ability, and make them good aviators. Many of his civilian students went on to become instructors themselves with one actually opening his own flying school. Due to this friendly but firm attitude of Homi, he was easily the most popular pilot in Indore Flying Club, with his popularity further enhanced by his good looks and easy-going personality. Every other evening, most of his students would gather at his small house in New Palasia in Indore for a cup of tea and a chat with Homi wherein Homi and his equally charming wife, Alma, would play the gracious hosts despite their meagre earnings from the flying club and Alma's nursing. Alma would also make everyone feel at home and comfortable leading to great inter-personal relations and confidence-building in the student pilots. This personal interaction was a major contributor to character-building in his pupils. Like they say, behind every successful man there is a woman and "Ally" was the one behind Homi. Soon after I joined the Air Force, my younger brother Deepak also flew with Homi for his Private Pilots Licence and Homi and Alma became family friends even with my parents. A few years later in 1969, Homi shifted to Bhopal Flying Club where I could still visit them quite frequently on my way to Indore on leave since most trains passed through Bhopal and we had to change trains there. After many years in Bhopal, Homi moved to Baroda where he flew for the flying club as the CPI as well as for an industry as their corporate pilot and I lost touch with Homi and Alma. It was one of those corporate flights that brought Homi to Poona in 1998 when I was commanding the base and we spent a great couple of hours together reviving our memories of the old days. It was my honour to host him even though it was a short trip and we got little time together before he had to fly back to Baroda. After retirement, I kept in touch with Homi and Alma and have visited them in Baroda a couple of times, always having a wonderful time with them. They remain great hosts as ever and I remain eternally grateful for having learnt so much from Homi Mistry, my very first flying instructor and a role model, with the same initials.

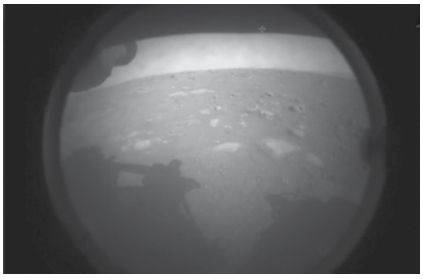
Representational photo: Rear quarter view of De Havilland DH.82A Tiger Moth at Avalon Airport, Australia, in March 2005 (Photo: Gsl-commonswiki)

Out of this world!

NASA's Mars Perseverance Rover on the Red Planet



This illustration shows NASA's Perseverance Rover casting off its spacecraft's cruise stage, minutes before entering the Martian atmosphere. Hundreds of critical events in the Rover's Entry, Descent, and Landing sequence would execute perfectly and exactly on time for the Rover to touch down on Mars safely. Image Credit: NASA/JPL-Caltech



First photo sent by the Rover on touchdown

The largest and most advanced Rover NASA has sent to another world touched down on Mars on 18 February 2021, after a 203-day journey traversing 293 million miles (472 million kilometers). Packed with groundbreaking technology, the Mars 2020 mission was launched 30 July 2020 from Cape Canaveral Space Force Station in Florida. The Perseverance Rover mission marks an ambitious first step in the effort to collect Mars samples and return them to Earth.

"This landing is one of those pivotal moments for NASA, the United States, and space exploration globally – when we know we are on the cusp of discovery and sharpening our pencils, so to speak, to rewrite the textbooks," stated acting NASA Administrator Steve Jurczyk. "The Mars 2020 Perseverance mission embodies our nation's spirit of persevering even in the most challenging of situations, inspiring and advancing science and exploration. The mission itself personifies the human ideal of persevering toward the future and will help us prepare for human exploration of the Red Planet."

About the size of a car, the 2,263-pound (1,026 kilogramme) robotic geologist and astrobiologist will undergo several weeks of testing before it begins its two-year science investigation of Mars' Jezero Crater. While the Rover will investigate the rock and sediment of Jezero's ancient lakebed and river delta to characterise the region's geology and past climate, a fundamental part of its mission is astrobiology, including the search for signs of ancient microbial life. To that end, the Mars Sample Return Campaign, being planned by NASA and ESA (European Space Agency), will allow scientists on Earth to study samples collected by Perseverance to search for definitive signs of past life using instruments too large and complex to send to the Red Planet.

Some 28 miles (45 kilometers) wide, Jezero Crater sits on the western edge of Isidis Planitia, a giant impact basin just north of the Martian equator. Scientists have determined that 3.5 billion years ago the crater had its own river delta and was filled with water.

The power system that provides electricity and heat for Perseverance through its exploration of Jezero Crater is a Multi-

In this illustration of its descent to Mars, the spacecraft containing NASA's Perseverance Rover slows down using the drag generated by its motion in the Martian atmosphere. Image Credit: NASA/JPL-Caltech

An illustration of NASA's Perseverance Rover landing safely on Mars. NASA's Mars 2020 Rover will store rock and soil samples in sealed tubes on the planet's surface for future missions to retrieve, as seen in these illustrations

Mission Radioisotope Thermoelectric Generator, or MMRTG. The US Department of Energy (DOE) provided this to NASA through an ongoing partnership to develop power systems for civil space applications. Equipped with seven primary science instruments, the most number of cameras ever sent to Mars, and its exquisitely complex sample caching system – the first of its kind sent into space – Perseverance will scour the Jezero region for fossilised remains of ancient microscopic Martian life, taking samples along the way.

Paving the Way for Human Missions

The Mars Entry, Descent, and Landing Instrumentation 2 (MEDLI2) sensor suite collected data about Mars' atmosphere during entry, and the Terrain-Relative Navigation system autonomously guided the spacecraft during final descent. The data from both are expected to help future human missions land on other worlds more safely and with larger payloads.

On the surface of Mars, Perseverance's science instruments will have an opportunity to scientifically shine. Mastcam-Z is a pair of zoomable science cameras on Perseverance's remote sensing mast, or head, that creates high-resolution, colour 3D panoramas of the Martian landscape. Also located on the mast, the SuperCam uses a pulsed laser to study the chemistry of rocks and sediment and has its own microphone to help scientists better understand the property of the rocks, including their hardness.

Located on a turret at the end of the Rover's robotic arm, the Planetary Instrument for X-ray Lithochemistry (PIXL) and the Scanning Habitable Environments with Raman & Luminescence for Organics & Chemicals (SHERLOC) instruments will work together to collect data on Mars' geology close-up. PIXL will use an X-ray beam and suite of sensors to delve into a rock's elemental chemistry. SHERLOC's ultraviolet laser and spectrometer, along with its Wide Angle Topographic Sensor for Operations and eNgineering (WATSON) imager, will study rock surfaces, mapping out the presence of certain minerals and organic molecules, which are the carbon-based building blocks of life on Earth.

The Rover chassis is home to three science instruments, as well. The Radar Imager for Mars' Subsurface Experiment (RIMFAX) is the first ground-penetrating radar on the surface of Mars and will be used to determine how different layers of the Martian surface formed over time. The data could help pave the way for future sensors that hunt for subsurface water ice deposits.

Also with an eye on future *Red Planet* explorations, the Mars Oxygen In-Situ Resource Utilisation Experiment (MOXIE) technology demonstration will attempt to manufacture oxygen out of thin air – the *Red Planet's* tenuous and mostly carbon dioxide atmosphere. The Rover's Mars Environmental Dynamics Analyser (MEDA) instrument, which has sensors on the mast and chassis, will provide key information about present-day Mars weather, climate, and dust.

Currently attached to the belly of Perseverance, the diminutive Ingenuity Mars Helicopter which is a technology demonstration that will attempt the first powered, controlled flight on another planet.

Project engineers and scientists will now put Perseverance through its paces, testing every instrument, subsystem, and subroutine over the next month or two. Only then will they deploy the helicopter to the surface for the flight test phase. If successful, Ingenuity could add an aerial dimension to exploration of the Red Planet in which such helicopters serve as a scouts or make deliveries for future astronauts away from their base.

Once Ingenuity's test flights are complete, the Rover's search for evidence of ancient microbial life will begin in earnest.

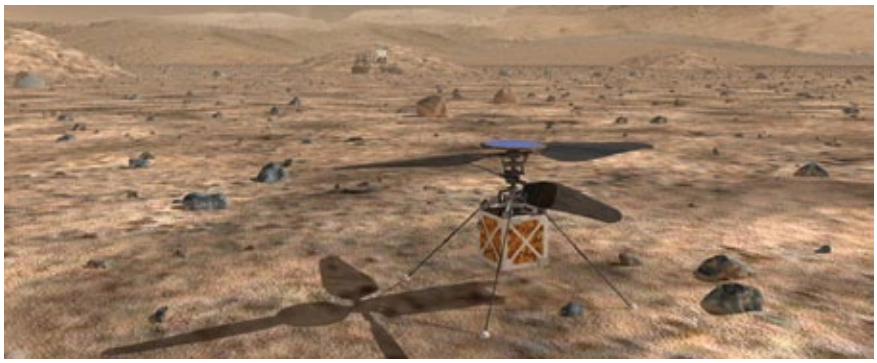
More about the Mission

A primary objective for Perseverance's mission on Mars is astrobiology research, including the search for signs of ancient microbial life. The Rover will characterise the planet's geology and past climate and be the first mission to collect and cache Martian rock and regolith, paving the way for human exploration of the Red Planet.

Subsequent NASA missions, in cooperation with ESA, will send spacecraft to Mars to collect these cached samples from the surface and return them to Earth for in-depth analysis.

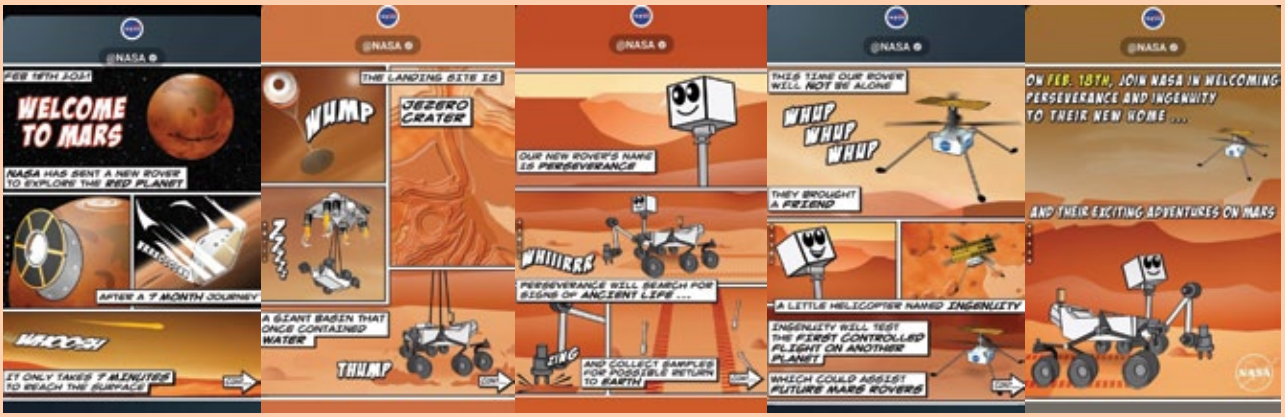
The Mars 2020 Perseverance mission is part of NASA's Moon to Mars exploration approach, which includes Artemis missions to the Moon that will help prepare for human exploration of the Red Planet.

JPL, a division of Caltech in Pasadena, California, manages the Mars 2020 Perseverance mission and the Ingenuity Mars Helicopter technology demonstration for NASA.

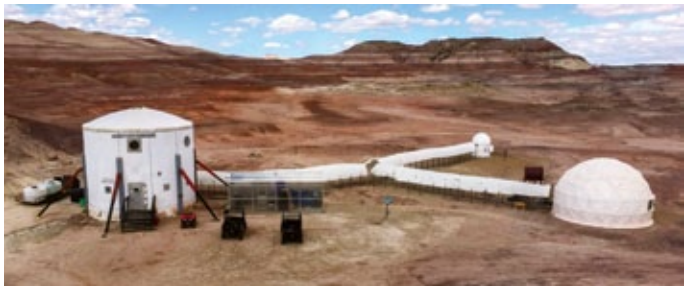


The Ingenuity Mars Helicopter, a small, autonomous rotorcraft, travelled with NASA's Mars Perseverance rover

The mission shown in simple cartoon form



(Courtesy: NASA)



All-female crew to Mars simulation centre

An all-female crew will visit the Mars Desert Research Station in Utah aiming to fill the data gap on women's performance in space exploration. Six engineers, geologists and scientists, all under 28-years-of age, will be going to the Mars simulation centre for a two-week mission.

The crew will be living in Mars-like conditions at the research station, including having to wear astronaut spacesuits when they venture outside for EVAs (Extra-Vehicular Activity) experiencing delays in messaging transmission and following a strict diet as they would in space. The desert area in Utah mimics the Martian landscape, and the station itself is similar to one that could be built on Mars.

Dragonfly launch moved to 2027

Dragonfly is a NASA mission that will deliver a rotorcraft to Saturn's moon Titan to advance our search for the building blocks of life. While Dragonfly was originally scheduled to launch in 2026, NASA has requested the Dragonfly team pursue their alternative launch readiness date in 2027. No changes will be needed to the mission architecture to accommodate this new date and launching at a later date will not affect Dragonfly's science return or capabilities once at Titan.

Airbus for ESA's Moon lander study

Airbus has been selected by the European Space Agency (ESA) as one of the two primes for definition phase of the European Large Logistic Lander (EL3). In this study (phase A/B1), Airbus will develop the concept of a large multi-role logistic lander able to transport up to 1.7 tons of cargo to any location on the lunar surface. EL3 flights are set to begin in the late 2020s, with a cadence of missions over the following decade and more.

Europe is already contributing to the Global Exploration Roadmap agreed by 14 space agencies around the world, in which Airbus is also playing its part. European participation includes international missions to Mars, substantial elements for crewed space stations – the International Space Station and the Lunar Gateway – and the Orion European Service Module (ESM) which will power Artemis, the next human mission to the lunar surface.

With EL3, ESA and its member states will make a further substantial European contribution to the international effort to establish sustainable exploration of the Moon. EL3 will be designed as a fully independent European lunar surface logistics mission capability, including European launch capability with Ariane 6. ESA anticipates flying three to five EL3 missions over a 10 year time frame.

EL3 will be launched on an Ariane 64 from Kourou as a single payload of up to 8.5 tons, can be put on a direct trajectory to the Moon, similar to the trajectory flown by Apollo 50 years back. After roughly four days of "barbecue-like travel" (ie slow and constant rotation to optimise the thermal control of the spacecraft), insertion into a low lunar orbit (LLO) will be achieved by EL3's own propulsion system. Depending on the launch window and the landing site on the Moon, EL3 might remain for up to 14 days in LLO, waiting for the right point in time and space to initiate landing.

Courtesy: NASA

25 Years Back

From Vayu Aerospace Review Issue V/1996

Mesco Airlines Training Centre

Mesco Airlines have established their Training Centre in New Delhi for imparting Flight Engineers' Basic and Type Training on the Mi-172 helicopter. The Directorate General of Civil Aviation (DGCA) has accorded its formal approval for this unique facility created by the airline.

INS "Vikrant" R.I.P.

Breaking any a naval heart is the news that (inevitably) the INS *Vikrant*, India's first aircraft carrier, will soon sail to the breaker's yard. According to an official answer in Parliament, "Of the two aircraft-carriers, INS *Vikrant* is now due for decommissioning as she has become unfit for combat."

"There is a proposal for outright purchase of an aircraft-carrier to replace INS *Vikrant,"* said Mr NVN Somu, the Minister of State for Defence. "There is also a proposal for indigenous production of an Air Defence Ship to eventually replace the carriers.

Committee To Review Aircraft Act 1934

The Ministry of Civil Aviation has set up a committee to review existing guidelines for granting permits to operators and a standing system to carry out safety audits of different aircraft categories. The committee will review and suggest changes in the Aircraft Act 1934 and the Aircraft Rules 1937. The Directorate General of Civil Aviation's (DGCA) existing staffing norms and organisation structure are to be reviewed as well.

Profits For Indian Airlines in 1997

Indian Airlines has declared a strategy to emerge from the red by March 1997 by increasing its daily seat capacity by 15 per cent, opening new air links and increasing flying ours of its fleet by 10 percent. According Civil Aviation Minister CM Ibrahim, "it will be zero loss for Indian Airlines in March 1997 and it will record a net profit next year".

IA Seeks JV for Engine Overhaul

For companies including the state-owned Hindustan Aeronautics Ltd (HAL) have been short-listed with which Indian Airlines will have a joint venture for engine overhauls, according to Civil Aviation Minister CM Ibrahim. The other companies are Pratt and Whitney of the US, Rolls Royce of the UK and France.

Alliance Air Joint Venture Bids

Alliance Air's efforts to form joint ventures with West Bengal, Maharashtra and Andaman & Nicobar Islands have so far failed to materialise with the respective governments evincing little interest in a 50-50 revenue sharing basis.

Second International Airport at Mumbai

The need for a second international airport at Mumbai is being felt as the Airport Authority of India has forecast that Sahara Airport will be saturated by 2005. According to Maharashtra Chief Minister Mohan Joshi, two sites for a new airport are being considered, one being Mandawa Rewas which has been included in the 20-year prospective plan formulated by the Bombay Metropolitan Area authorities. The second site is proposed to be at New Bombay.

Private Airlines To Fly Foreign Routes?

The Tourism Ministry has prepared a comprehensive strategy paper which contains a proposal that domestic private airlines should be allowed to operate on international routes. The ministry has urged the government to identify private airlines also, depending upon their operational capability, as designated carriers under the air service bilateral agreements signed by India with other countries.

USAF and IAF Establish Sister Squadrons'

Achieving a significant FIRST, curiously before the Indian and Royal Air Forces have done so, is the recently established sister squadron basis between the United States and the Indian Air Force.

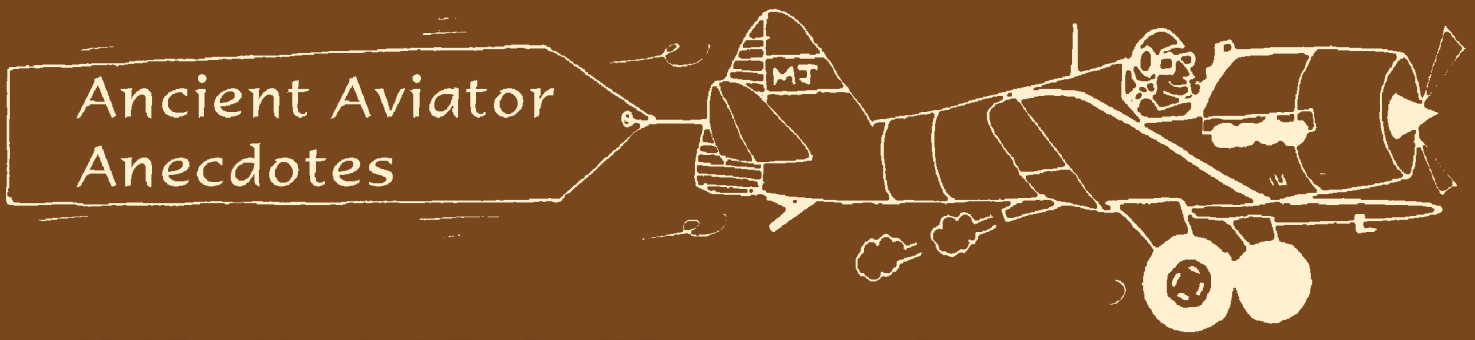
"82 IAF Aircraft Lost Since April '93"

The Government has disclosed that the Indian Air Force lost 82 aircraft in crashes during the last three-and-a-half years since April 1993, resulting in a loss of Rs 457.5 crore. The loss accounts for nearly four-and-a-half squadrons worth of aircraft, almost all of which were fighters. In this calendar year alone, the IAF has lost 15 aircraft, including an Mi-17 transport helicopter, suspected to have been shot down by Pakistani forces during routine sortie in the Siachen glacier region.

The IAF has been losing on an average between 22 and 24 aircraft annually since 1993, but his is the first time the government has tabled precise figures in Parliament although it has not given a break-up of the dates, cause and type of aircraft lost in crashes for security reasons. In 1994, the IAF lost as many as 31 aircraft including a Mirage 2000 and a MiG-29.

"2 Prototypes of LCA to fly Next Year": Kota

Two prototypes of the Light Combat Aircraft (LCA) Technology Demonstrations, will fly in the middle of next year, Dr Kota Hari Narayana, LCA Project Director, Aeronautical Development Agency, stated at Bangalore on 20 September. He said that integration phase of the first prototype had been completed, with the structural testing being completed as recently as 19 September. "Testing of the electricals and avionics will begin shortly, and then we will move on to the flight control system. The critical thing is to prove beyond doubt that the aircraft is safe," he said.



Air Vice Marshal (R) Cecil Parker and his.....

AUGUST ASSOCIATION(S)

Photo for reference purpose only: DH113 Vampire NF54 ID606 of the Indian AF on display at Palam, New Delhi. (Image by BAE Systems/Ron Smith)

30 August 2021 marks 69 years since No 58 Pilots Course (PC) was commissioned into the IAF at Begumpet by AVM Subroto Mukherji the then DCAS. The members of this PC were born in the early 1930s when the first of our pioneer Indian military aviators joined the RAF; Subroto Mukherji himself was commissioned on 8 October 1932. Our generation grew up in the colonial era, were in school during World War II (WW-II), celebrated Independence and lived through Partition. Post WW-II the RIAF evolved out of the RAF and soon after Partition, had to independently undertake air support operations in J & K with depleted numbers of Dakota, Spitfire and Tempest aircraft and manpower. The first jet aircraft (Vampires) were acquired in 1948 and the initial expansion of our air force commenced. On becoming a Republic in 1950, the IAF emerged from the RIAF. Most of us future pilot trainees of No 58 PC were at that time college students and entered for the FPSC entrance exam for the IAF. After clearing the same, along with selection/medical boards, fifty of us reported in early 1951 to No 1 AFA in Ambala and No 58 PC was born. Shortly thereafter the academy was relocated to Begumpet.

Pilot training was then of 18 months duration; nine months on the Tiger Moth (Basic Stage) and Harvard (Advanced Stage). Standards were high and our course had a 40% attrition rate with just 30 of us (plus a naval aviator) graduating as Pilot Officers and earning our wings on 30 August 1952. 17 of our coursemates moved to TTW Agra for twin-engined conversion and thereafter flew Dakota, Liberator, Packet, AN -12, AN- 32, Super Constellation, IL-14, Avro748, Viscount, Devon, Canberra and the first Chetak helicopters. The other 13 of us, along with the naval aviator, moved to CTU Hakimpet for fighter conversion on Spitfire and Tempest and thereafter to squadrons flying Vampire, Toofani, Mystere, Gnat, Hunter, MiG and Marut plus the HT-2, Prentice, Iskra and Kiran during our instructional tenures. The very last member of our course to retire, did so in 1988.

From our course came an early generation of test pilots, QFI / IRIs, Sqn Cdr / CFIs, CO /, CIs, Stn Cdr / AOCs, Commandants and an Air Attache. They participated in both the 1965 and 1971 Indo-Pak wars with one member earning an MVC. In its first few years our course lost seven pilots in flying accidents, three each from transport and fighter aircraft plus one from a rotary wing. Since then, over the years another 15 have passed on due to natural causes. This leaves nine of us surviving members (as on date) of whom three are nonagenarians and the other six nearly there! Age, distance (plus Covid restrictions) no longer permit the many happy get-togethers we enjoyed in the past, commencing with a memorable 'Bees Saal Baad' reunion in Delhi on 30 August 1972, but the internet and smartphone keep us in touch. In Oct/Nov this year our air force and the author will both mark their 89th birthdays; another august association for this ancient aviator.

Tale Spin

Naked and checkmated?

Rostec and Sukhoi took the "revealing" and "naked" theme quite seriously by releasing daily images of their new 5th Gen single engine stealth fighter, unofficially nicknamed the 'Checkmate'. With every passing day pre-MAKS-2021, one got to see the slow strip/reveal!! Now that's a catchy and gripping PR stunt.

Good incentive to get people Covid vaccinated. With sizeable discounts for the 1st and 2nd doses, when can we get our booster shots?

(photo from Twitter)

Quirky realities. Life in the Covid era as well as the aviation industry

(Images from internet)

Afterburner

FLY NAVY, FLY

A HISTORY OF INDIAN NAVAL AVIATION

PUSHPINDAR SINGH
ANGAD SINGH

F-21: For India.
From India.

The F-21 offering exclusively for the Indian Air Force will provide state-of-the-art capabilities while putting Indian industry at the epicenter of the world's largest fighter production and sustainment market in support of Atmanirbhar Bharat.
Learn more at lockheedmartin.com/f21.

Lockheed Martin. Your Mission is Ours.®

LOCKHEED MARTIN