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VOL 23 ISSUE 8 • 2020

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AIE KOCHI INCIDENT

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DON'T JUST BLAME THE PILOT

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HAD THEIR TWO ARTICLES NOMINATED AS FINALISTS

AND INDEED, SP GUIDE PUBLICATIONS IS FURTHER PROUD TO STATE
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PUBLISHER AND EDITOR-IN-CHIEF
Jayant Baranwal
SENIOR EDITOR
Air Marshal B.K. Pandey (Retd)
DEPUTY MANAGING EDITOR
Neetu Dhulia
SENIOR TECHNICAL GROUP EDITOR
Lt General Naresh Chand (Retd)
GROUP EXECUTIVE EDITOR
Vishal Thapar
STAFF CORRESPONDENT
Ayushee Chaudhary
CONTRIBUTORS
India: Group Captain A.K. Sachdev (Retd), Group Captain Joseph Noronha (Retd)
Europe: Alan Peaford
USA & Canada: LeRoy Cook
CHAIRMAN & MANAGING DIRECTOR
Jayant Baranwal
PLANNING & BUSINESS DEVELOPMENT
Executive Vice President: Rohit Goel
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DEPUTY MANAGER - CIRCULATION
Rimpy Nischal
GROUP RESEARCH ASSOCIATE
Survi Massey
RESEARCH ASSISTANT
Sarthak Baranwal
DESIGN
Holistic Directions: Jayant Baranwal
Designers: Vimlesh Kumar Yadav, Sonu S. Bisht
GROUP DIRECTOR - SALES & MARKETING
Neetu Dhulia
DEPUTY DIRECTOR - SALES
Rajeev Chugh
SP'S WEBSITES
Sr Web Developer: Shailendra P. Ashish
Web Developer: Ugrashen Vishwakarma

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New Delhi 110003, India.
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Fax: +91 (11) 24647093
E-mail: info@spguidepublications.com
Representative Office
BENGALURU, INDIA
204, Jal Vayu Vihar, Kalyan Nagar,
Bengaluru 560043, India.
Tel: +91 (80) 23682204
MOSCOW, RUSSIA
LAGUK Co., Ltd., (Yuri Laskin)
Krasnokholmskaya, Nab.
11/15, app. 132, Moscow 115172, Russia.
Tel: +7 (495) 911 2762
Fax: +7 (495) 912 1260
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COVER IMAGE

The United Kingdom (UK)'s Future Combat Air System (FCAS) for the RAF and other European air forces and for export is the project to develop the next generation combat aircraft, known as Tempest, which will replace the Eurofighter Typhoon and serve in the RAF alongside the Lockheed Martin F-35. (Pic: ASDS Media)

COVER DESIGN BY
SP's Team

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NEXT ISSUE: *IAF Special*

> "There is no virtue like protecting the nation, there is no vow like defence of the nation. You who touch the skies, welcome!" – Prime Minister Narendra Modi on the arrival of Rafale in India.

A RECENT LAND MARK EVENT FOR THE INDIAN AIR FORCE (IAF) was the arrival of the first five of the 36 Rafale jets procured from Dassault Aviation through a direct deal between the Indian government and the government of France. Hopefully, the remaining 31 aircraft would be delivered by the Original Equipment Manufacturer soonest possible as procurement of these 4.5 generation platforms will mark the commencement of the process of restoration of the operational capability of the IAF. This issue of *SP's Aviation* includes a report on the arrival of the fighters in India and also carries a viewpoint in which Air Chief Marshal S. Krishnaswamy (Retd) former Chief of the Air Staff, IAF highlights the capability of this platform as compared to the other combat jets on the inventory of the IAF and what the commencement of delivery of this fleet means for the service.

One achievement of immense significance for the global aerospace industry has been the successful development of the twin-engine, medium-lift military transport aircraft by Embraer. Dubbed initially as the KC-390 and later renamed as the C-390 Millenium, this is the largest, heaviest and most complex military aircraft designed, developed and produced by Embraer. It is a clear evidence of the level of aerospace technology that Embraer has achieved. We have a report by Air Marshal B. K. Pandey (Retd) on the development, production, delivery and induction of this platform in to the Brazilian Air Force.

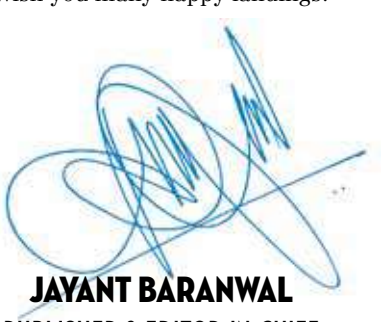
Air India Express, a subsidiary of the national carrier Air India, met with a serious accident at Calicut International Airport on August 07 this year when the aircraft encountered extremely adverse weather conditions while landing and fell into a 35-foot deep gorge. Fortunately, the fatalities were very low, but the aircraft was a complete write off as the fuselage broke into two pieces. As in any flying accident, the pilot in command is generally held responsible for the episode. However, not only in this particular case, but in all flying accidents, the public at large and particularly those holding important positions in the civil aviation domain, must refrain from immediately assigning responsibility and wait for the investigation by the appropriate agency to be completed. A report on the disaster by Air Marshal B.K. Pandey (Retd) has been included in this issue of the magazine.

With rapid advances in technology, Electronic Warfare (EW) is becoming increasingly potent and India too is not far behind as all the three wings of the Indian armed forces are moving forward to enhance their offensive and defensive capabilities through major strides in this domain. This issue of the magazine carries a detailed analysis of the trends in EW by Air Marshal Anil Chopra (Retd) and observes that in this domain, indigenisation remains a major challenge for the nation.

The global Coronavirus pandemic brought some unprecedented situations and new challenges and therefore, this year, the Farnborough International Airshow (FIA) went online. Under the name of FIA Connect, there were a series of virtual events taking place during the week of what would have been the FIA. Included in this issue is a report by Ayushee Chaudhary on the various sessions and panel discussions held in the FIA Connect programme.

All this and more in this issue of *SP's Aviation*. Welcome aboard and we wish you many happy landings!

Jai Hind!



JAYANT BARANWAL
PUBLISHER & EDITOR-IN-CHIEF

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LEADING BY EXAMPLE

CAS FLIES THE MIG-21 BISON

(TOP AND ABOVE): CHIEF OF THE AIR STAFF, AIR CHIEF MARSHAL R.K.S. BHADAURIA PREPARING FOR A SORTIE ON MIG-21 BISON AIRCRAFT DURING HIS VISIT TO A FRONTLINE AIR BASE IN WESTERN AIR COMMAND ON AUGUST 13, 2020.

AIR CHIEF MARSHAL R.K.S. BHADAURIA, CHIEF OF THE AIR STAFF (CAS) visited a frontline air base in Western Air Command on August 13, 2020. On his arrival, the CAS was received by the Air Officer Commanding (AOC) of the base who briefed him on the readiness and operational status of the lodger units located at the base. During the day-long visit, the CAS reviewed the operational preparedness of the base and interacted with air warriors serving on the frontline. The CAS urged the air warriors to maintain the highest standards of readiness. He also appreciated their efforts in preserving IAF's combat potential during the ongoing COVID-19 pandemic.

Earlier in the day, the CAS flew the MiG-21 Bison with the resident squadron. In doing so, the Air Chief displayed "exemplary leadership" and boosted the morale of all the pilots. He also showed that MiG-21 Bison still a very capable aircraft. The plane had shot into prominence when it shot down a Pakistani Air Force F-16 during the aftermath of the Balakot air strikes by the IAF in February 2019.

Air Chief Marshal Bhadauria is himself a test pilot and after taking over, has clearly shown support for indigenous defence products by flying the under-development HTT-40 basic trainer aircraft and the LCA Tejas while also backing several important DRDO projects. He has over 4270 hours of experience on twenty seven types of fighters as well as transport aircraft and holds the unique distinction of being an Experimental Test Pilot, a Cat 'A' Qualified Flying Instructor and a Pilot Attack Instructor. He was the Commanding Officer of Flight Test Squadron at Aircraft & System Testing Establishment and Chief Test Pilot as well as Project Director of National Flight Test Centre on Tejas Light Combat Aircraft (LCA) project. He was extensively involved in the initial prototype flight testing on the LCA. SP

—SP's Correspondent

PHOTOGRAPHS: IAF

CHIEF OF THE AIR STAFF, AIR CHIEF MARSHAL R.K.S. BHADAURIA, AIR OFFICER COMMANDING-IN-CHIEF WESTERN AIR COMMAND, AIR MARSHAL B. SURESH AND AIR OFFICER COMMANDING AIR FORCE STATION AMBALA WITH THE PILOTS OF THE FIRST RAFALE AIRCRAFT THAT ARRIVED AT AIR FORCE STATION AMBALA.

THE ARRIVAL OF BEAUTY AND THE BEAST

Five Rafale - "Delight to Fight" as said by a senior from IAF, out of the 36 finalised in an inter-governmental deal with France by Prime Minister Modi, arrived on Wednesday at Ambala and are to be formally inducted in the IAF in August

By AYUSHEE CHAUDHARY

INDIA TOOK A SIGNIFICANT STEP IN STRENGTHENING AIR power and defence preparedness with the first five Rafale fighter aircraft, built by Dassault, flying out from Merignac airbase in Bordeaux, France to India. These five Indian Air Force (IAF) Rafale aircraft arrived at Air Force Station, Ambala on Wednesday, July 29, 2020. Planned in two stages, the ferry from France was undertaken by Indian Air Force (IAF) pilots who had been undergoing training there. The Medium Multi-Role Combat Aircraft (MMRCA) aircraft covered a distance of nearly 8,500 km from France to India. The three single-seat and two twin-seat omni-role fighters were flown by seven IAF pilots and led by Commanding Officer Group Captain Harkirat Singh. Air Chief Marshal R.K.S. Bhadauria visited Ambala to receive this first batch of five Rafale combat aircraft arriving from France.

PHOTOGRAPH: IAF

PM WELCOMES RAFALE; DM CALLS IT A TIMELY BOOST

As the Rafale jets landed in Ambala, the Prime Minister welcomed the aircraft with a tweet containing a few verses in San-

skrit along with a brief video of the landing at the Ambala Air Force station.

The tweet roughly translates into, "There is no virtue like protecting the nation, there is no vow like defence of the nation and there is no sacrifice like the defence of the nation. You who touch the skies, welcome". This highlighted the importance of national security and strengthened the role of Rafale, coming straight from the leader of the nation.

Defence Minister Rajnath Singh welcomed the aircraft by saying, "The Birds have entered the Indian airspace... Happy Landing in Ambala!" The Minister congratulated the IAF on professionally executing the ferry and said, "I am sure that 17 Squadron, the Golden Arrows, will continue to live upto their motto of 'Udayam Ajasram'. I am extremely happy that IAF's combat capability has got a timely boost."

> The IAF stated that the aircraft will be a part of 17 Squadron, the "Golden Arrows", which was resurrected on September 10, 2019. The Squadron was originally raised at Air Force Station, Ambala on October 1, 1951

He further said that the touchdown of Rafale combat aircraft in India marks the beginning of a new era in our Military History. These multirole aircraft will revolutionise the capabilities of the IAF. Highlighting the capabilities of the aircraft, Singh also remarked that, "This aircraft has very good flying performance and its weapons, radar and other sensors and electronic warfare capabilities are amongst the best in the world. Its arrival in India will make the IAF much stronger to deter any threat that may be posed on our country."

Rajnath Singh thanked Prime Minister Narendra Modi for his right decision. "The Rafale jets were purchased only because Prime Minister took the right decision to get these aircraft through an Inter-Governmental Agreement with France, after the long pending procurement case for them could not progress." He also thanked the French Government, Dassault Aviation and other French companies for ensuring the timely delivery of the aircraft and its weapons, despite the severe restrictions posed by COVID-19 pandemic.

Defence Minister Singh added that, "The Rafale jets were purchased when they fully met the operational requirements of the IAF. The baseless allegations against this procurement have already been answered and settled." He added, "If it is anyone who should be worried about or critical about this new capability of the Indian Air Force, it should be those who want to threaten our territorial integrity."

RAFALE – 17 "GOLDEN ARROWS" SQUADRON OF THE IAF

The IAF stated that the aircraft will be a part of 17 Squadron, the "Golden Arrows", which was resurrected on September 10, 2019. The Squadron was originally raised at Air Force Station, Ambala on October 1, 1951. The 17 Squadron has many firsts to its credit; in 1955 it was equipped with first jet fighter, the legendary De Havilland Vampire. In August 1957, the Squadron became the first to convert on to a swept wing fighter, the Hawker Hunter, IAF highlighted. A formal induction ceremony of Rafale aircraft in 17 Squadron is scheduled to be held in the second half of August 2020, IAF informed.

The arrival of the first five of Rafale from the multibillion dol-

RAFALE, A MAJOR QUALITATIVE ADDITION TO COMBAT CAPABILITIES

Even if these are only five of the aircraft, to be joining the IAF, it is certainly a qualitative addition to the combat capabilities of the Indian Air Force (IAF) and hold omni-potential possibilities. The ability to strike air-to-air targets from up to 150 km away and safely hit land targets 300 km within enemy territory make India's Rafales some of the deadliest fighter jets flying in the world. The French-made Rafales, known for air-superiority and precision strikes, are India's first major acquisition of fighter planes in 23 years after the Sukhoi jets were imported from Russia.

The state-of-the-art 4.5 Generation Rafale jet can reach almost double the speed of sound, with a top speed of 1.8 Mach.The aircraft can carry a range of potent weapons including European missile maker MBDA's Meteor beyond visual range air-to-air missile, SCALP cruise missiles and MICA weapons system will be the mainstay of the weapons package of the Rafale jets.

Meteor is the next generation of BVR (Beyond Visual Range) air-to-air missile (BVRAAM) designed to combat common threats facing the UK, Germany, Italy, France, Spain and Sweden. The Meteor is powered by a unique rocket-ramjet motor that gives it far more engine power for much longer than any other missile. The Meteor missile can target enemy aircraft from 150 km away and destroy enemy aircraft before they actually even get close to the Indian aircraft.

The SCALP cruise missiles are capable of hitting the targets 300 km away while the MICA is a very versatile air-to-air missile. It comes with a radar seeker, an infrared seeker and it can be fired for the short-range to long-range, right up to a 100 km. The Indian Air Force is also procuring new generation medium-range modular air-to-ground weapon system Hammer to integrate with the Rafale jets. Hammer (Highly Agile Modular Munition Extended Range) is a precision-guided missile developed by French defence major Safran.

Apart from the weapons, Rafale also fly with SPECTRA - widely considered to be the world's most advanced fighter-based electronic warfare suite, a system which is the cornerstone of the Rafale's survivability against a host of latest threats. By detecting threats at long-range, SPECTRA allows the pilot to instantly select the best suited defensive measures combining radar jamming of ground and airborne radars and the deployment of infrared or radar decoying flares and chaff.

Flown by French forces, the Rafale has also been used in operations in Afghanistan, Libya, Mali, Iraq and Syria, Dassault Aviation says on its website. SP

INDUCTION OF RAFALE FIGHTERS INTO IAF: A TIMELINE

2001: IAF conveys requirement for 126 Mirage 2000 fighters as replacement for legacy MiG variants. Foreign fighter needed because of big delay in indigenous LCA programme.

2001

2001-2004: Government accepts necessity of foreign supplied fighters but rejects single-vendor procurement, decides to acquire fighters through global tender route.

2001-2004

November 2004: IAF issues RFI to Russia's Mikoyan Gurevich/ Rosboronexport for MiG-29, American Lockheed Martin for F-16, Swedish Saab for Gripen and French Dassault for Mirage 2000 as a precursor to the biggest global tender for fighter aircraft.

2005

June 2005: India agrees to include American Boeing and European consortium Eurofighter for the F/A-18 Super Hornet & Typhoon respectively into the competition, now labelled the Medium Multi-Role Fighter Aircraft (MMRCA) programme.

2006

February 2006: France offers to shift the Mirage 2000 line to India outside of the competition. Upon India's rejection of this "unsolicited proposal", Dassault withdraws the offer for Mirage 2000 and offers the Rafale instead.

2007

August 28, 2007: India issues RFP for procurement of 126 MMRCA to Rosboronexport (MiG-29/35), Lockheed Martin (F-16), Saab (Gripen), Dassault (Rafale), Boeing (F/A-18) & Eurofighter (Typhoon) to set up the final line-up for the competition.

2011

May 2011: IAF shortlists Rafale & Eurofighter after extensive technical & flight trials.

2012

January 2012: Dassault bid for the Rafale declared L1.

2014

March 2014: Workshare agreement signed between HAL & Dassault for building 108 Rafale fighters in a 70:30 ratio. First 18 jets intended to be delivered in flyaway condition by Dassault.

lar deal has been amid tensions persisting along the defacto border of India and China. Indian and Chinese forces were locked in a six-week-long standoff along their border that peaked with a hand-to-hand battle in which 20 Indian soldiers were killed last month. These fighters, dubbed "game-changers" by IAF, have touched down in the middle of the ongoing military confrontation with China. Thus the timing of combat jets' arrival has further gained spotlight on as they were greeted with a water-cannon guard of honour when they landed at the Ambala air base in Haryana. While the first squadron of the Rafale jets is expected to be stationed at Ambala air base, the second one will apparently be based at Hasimara air base in West Bengal.

FROM FRANCE TO INDIA

This also marks a new milestone in the strong and growing India-France defence cooperation, stated the press statement issued by the Embassy of India, Paris. India's Ambassador to France, Jawed Ashraf was there to see off Rafale aircraft. He said that the long awaited and much needed two squadrons of Rafale would add great strength to IAF and our defence capabilities. He met the IAF pilots and wished them a safe flight to India. He congratulated them on becoming the first Indian pilots to fly one of the most advanced and potent fighter aircraft in the world and wished them success in meeting the nation's expectation of playing an important role in India's defence. He called the Rafale, the real beauty and the beast and an aircraft that is swift, nimble, versatile, advanced and lethal.

The first stage of the flight covered a distance of 5,800 km in seven and a half hours. The aircraft got airborne from Dassault Aviation Facility, Merignac, France on the morning of July 27, 2020 and reached India on Wednesday afternoon with a planned stopover en-route at Al Dhafra airbase in the UAE.

April 8, 2015: The then Foreign Secretary says detailed discussions underway between MoD, HAL & Dassault amidst reports of an impasse on account of labour costs and acceptance of responsibility for the jets to be made in India under license.

July 30, 2015: India announces withdrawal of the MMRCA tender for 126 aircraft.

September 23, 2016: India signs a ₹60,000 Crore Inter-Governmental Agreement with France for the purchase of 36 Rafale fighters. First jet to be delivered after 36 months. All 36 to be delivered by April 2022.

July 29, 2020: The first batch of 5 Rafale fighters fly in to the Ambala airbase in the resurrected 17 (Golden Arrow) Squadron. Group Captain Harkirat Singh is the first Commanding Officer of the IAF's first Rafale squadron.

2015 **2016** **2019** **2020**

April 10, 2015: New deal for acquisition of 36 Rafale fighters in fly-away condition announced after a Summit meeting between Prime Minister Narendra Modi and French President Francois Hollande in Paris.

January 26, 2016: India, France sign MoU for the acquisition of 36 Rafale fighters for the IAF.

October 8, 2019: First IAF Rafale ceremonially handed over to Defence Minister Rajnath Singh at Dassault's Merignac facility near Bordeaux in South-West France. Singh performs Shastra Puja while accepting to the aircraft, flies tandem Rafale sortie.

French Air Force (FAF) Tanker provided dedicated Air-to-Air Refuelling support during the flight. The second stage of the flight covering over 2,700 km was carried out with Air-to-Air Refuelling by IAF Tanker. The Ambassador as well as the IAF appreciated the proactive support provided by the French Government and Industry in France to ensure timely delivery. The tanker support extended by FAF during the ferry was crucial in ensuring that the long haul flight was accomplished successfully and in a time bound manner.

The five Rafale aircraft were escorted by two armed SU-30MKIs as they entered Indian airspace. Captain of the Indian Naval Ship (INS) Kolkata welcomed Rafale Arrow Leader in the Indian Ocean by saying, "May you touch the sky with glory."

In April 2015, Prime Minister Narendra Modi had announced the purchase of 36 Rafale jets after talks with the then French President Francois Hollande during his visit to the country. A deal was finalised when Hollande visited New Delhi to participate in the Republic Day celebrations in January 2016. The arrival of the aircraft comes two decades after IAF first demanded such fighters. The first Rafale fighter was handed over to the IAF in October 2019 in a ceremony attended by the French Minister for Armed Forces Madame Florence Parly and the Indian Defence Minister Rajnath Singh. Delivery of ten aircraft has been completed on schedule. Five of these have arrived and the remaining five will stay back in France for training mission. The delivery of all thirty six aircraft will be completed on schedule by the end of 2021.

In accordance with the contract, IAF pilots and supporting personnel have been provided full training on the aircraft and weapon systems by Dassault and further batches of IAF personnel will continue training over the next nine months. SP

Induction of Rafale Jets signifies a great trust and responsibility being imposed on those who will manage, maintain, support and fly these wonderful war-fighting machines

By **AIR CHIEF MARSHAL S. KRISHNASWAMY (RETD)**

RAFALE: INDUCTION OF A NEW GENERATION IN WAR-FIGHTING

COMBAT AIRCRAFT ARE PRIMARILY WEAPONS OF WAR AND their potentials define their ability in war-fighting. In 1965, our pilots fought air battles flying the Gnat that had just two guns but no missiles or on-board radar which is unthinkable these days. The MiG-21s that we acquired in the late '60s and right through the '80s flew much faster, had a rudimentary radar' but were limited in respect of payload and range.

A void was felt in the capability of the Indian Air Force (IAF) to strike deep inside the enemy territory. That called for the induction of a fleet of Deep Penetration Strike Aircraft (DPSA) that could carry twice the load of the MiGs and fly double the range. The Jaguar came in 1979 as the DPSA which had an inertial navigation system, the accuracy of which was hitherto unheard of. These aircraft could deliver weapons with pin-point accuracy; but were limited in manoeuvrability. Then came, the air-superiority fighters that were designed with relaxed stability to achieve super-manoeuvrability by virtue of electronically-driven flight controls.

Air superiority fighters such as the F-16, Mirage 2000 and MiG-29, ruled the skies over the earlier generation of combat aircraft. Further advances in aerodynamics, lighter alloys and composite material, helped in developing fighters capable of carrying more fuel and payload without losing out on super-manoeuvrability. These were the Su-30 family of aircraft, the Eurofighter and the French Rafale. American fighters such as the F-22 and F-35 had added capabilities like Stealth that made them fifth–generation fighters. Most of these aircraft are capable of performing 'Swing Role' whilst in the air on a strike mission, to be swung to perform air superiority and have the extraordinary ability to cruise at supersonic speeds without sustained use of engine after-burners.

The Rafale jets of the IAF can carry a weapon load twice that of the Jaguar, covering a much farther range and yet performing effectively the role of a nimble air superiority fighter. The French have proved admirable in pursuing research in high-end technologies independently and succeeded in developing a variety of products of their own brand in a highly competitive area of aerospace engineering. Their success reflects fine leadership, cohesion of their military and scientific community as well as strong governmental support. Besides the airframe and engine, the French also developed the entire range of sensors and Electronic Warfare (EW) systems and have integrated these, right at the design stage.

RAFALE BEING REFUELED IN THE AIR ON THEIR WAY TO INDIA

We must not forget that the Project Development Phase of the Light Combat Aircraft was actively supported by the French exploiting their experience in developing the Mirage 2000. We could certainly try and emulate the French leadership and cohesion in developing our own aircraft and weapon systems.

It was a joy to see the first five Rafale Jets land so gracefully on the runway at Ambala. Hats-off to all those, who persevered for years, to get the Rafale inducted into the IAF. These Jets entering our own hangars signifies a great trust and responsibility being imposed on those who will manage, maintain, support and fly these wonderful war-fighting machines that will soon join the other protectors of our nation – and touch the sky with glory! SP

PHOTOGRAPH: IAF

C-390 MILLENNIUM

SUCCESSFULLY ACCOMPLISHING MISSIONS

The C-390 MILLENNIUM multi-mission aircraft is delivering in service with the Brazilian Air Force, fulfilling expectations, and helping with support during the Covid-19 Pandemic. By combining state-of-the-art advanced systems and proven technologies with a worldwide network of reputable suppliers, the C-390 MILLENNIUM is a versatile addition to any air force and is the most reliable, easy to operate and efficient aircraft in its class.

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Photographic record made by the Brazilian Air Force on one of the missions to combat COVID-19 in Brazil.

IN ACTION: C-390 MILLENNIUM IS A NEW GENERATION TRANSPORT AIRCRAFT WITH MULTI-MISSION CAPABILITIES WHICH COMBINES A HIGHLY FLEXIBLE PLATFORM WITH THE LOWEST LIFE CYCLE COST IN THE MEDIUM AIRLIFT MARKET

A VERSATILE BIRD FROM BRAZIL

The C-390 is the largest, heaviest and most complex military aircraft designed, developed and produced by Embraer and it signifies the level of aerospace technology that Embraer has achieved

By **AIR MARSHAL B.K. PANDEY (RETD)**

PHOTOGRAPH: EMBRAER

HISTORICALLY, DEVELOPMENT OF MEDIUM AND HEAVY-LIFT military transport aircraft had generally been confined to the aerospace industry of the United States (US), Russia and Europe. However, in April 2007, the Brazilian aerospace major Embraer, declared its intention to develop its first twin-engine, medium-lift military transport aircraft. In March 2008, the Government of Brazil came forward to assist the initial development programme with an investment of about $33 million. Two months later, the Brazilian Congress released $440 million for the development of the aircraft.

BACKGROUND

Prior to this proposed venture, in the1970s and early 1980s, Embraer that had been established in 1969, produced highly successful small size military aircraft for basic and advanced stages of training such as the Embraer AT-26 Xavante jet trainer and the Embraer EMB 312 Tucano turboprop trainer. The company also produced the A-29 Super Tucano, a light attack and close air support aircraft. In the large aircraft category, Embraer had produced aeroplanes for the civil aviation industry beginning in 1985 with the EMB Brasilia. Meant largely for the export market, this aircraft was the first in a series of highly successful small and regional airliners. Later, Embraer had produced several models of the E-Jets for civil aviation that have been and are being utilised for regional aviation across the world. The largest in the family of E-Jets is the E-190 that is capable of airlifting payload of 13 tonnes. Since its establishment in 1969, to date, Embraer has delivered a variety of aircraft with the total number being in the region of 9,000.

PLAN TO DEVELOP THE C-390

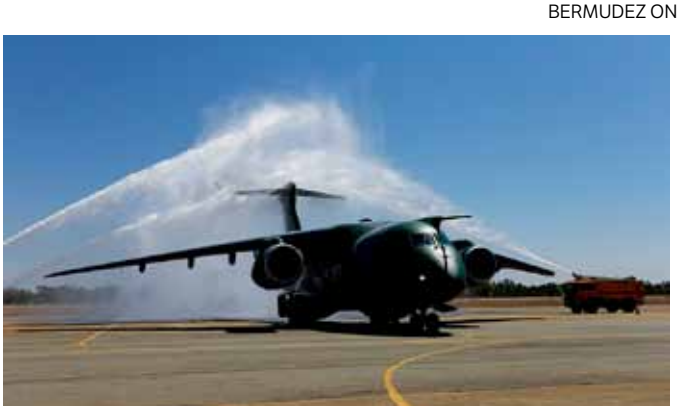
The newly announced project to develop a military transport aircraft in the medium-lift category, was planned to be undertaken by Embraer in collaboration with and financial support from the Brazilian Air Force known in Portuguese as Força Aérea Brasileira (FAB), that was to be the first customer. As per plans, the aircraft was to be capable of airlifting around 23 metric tonnes of payload and was to have multi-mission capability. The platform was initially christened as the KC-390, but in 2019, it was renamed as the C-390 Millennium, a name that the aircraft carries today. The plan as projected by Embraer was to develop a platform that would be able to compete with the Lockheed Martin C-130 Hercules in terms of performance parameters. One of the objective of Embraer was to replace the fleet of C-130s serving with the FAB. As against the C-130 powered by four turboprop engines, the C-390 Millennium is powered by two jet engines.

C-390 SPECIFICATIONS

PERFORMANCE	
Maximum Payload (Concentrated)	26 metric tonnes | 57,320 lb
Maximum Payload (Distributed)	23 metric tonnes | 50,706 lb
Wing Usable Fuel Capacity	23.9 metric tonnes
Maximum Cruise Speed	470 KTAS/Mach 0.80
Altitude Ceiling	36,000 ft
Sea Level Cabin	18,000 ft
Range with 26 metric tonnes (57,320 lb)	1,140 nm
Range with 23 metric tonnes (50,700 lb)	1,520 nm
Ferry Range	3,310 nm
Ferry Range with internal tanks	4,600 nm
Takeoff Dist (CFL, SL, ISA, 500 nm, payload 23 metric tonnes)	1,524 m | 5,000 ft
Takeoff Dist (CFL, SL, ISA, 500 nm, payload 16 metric tonnes)	1,165 m | 3,820 ft
Vref with 25 klb of useful load	116 KCAS
Normal Landing Dist (SL, ISA, 26 metric tonnes)	1,000 m | 3,280 ft
DIMENSIONS	
Length	35.20 m | 115 ft 5 in
Height	11.84 m | 38 ft 10 in
Wing Span	35.05 m | 115 ft
CARGO HOLD	
Length (Floor + Ramp)	18.50 m | 60 ft 8 in
Height (Minimum)	2.95 m | 9 ft 8 in
Width	3.45 m | 11 ft 4 in
Volume	169 m^3 | 5,970 ft^3
MAIN SYSTEMS	
IAE V2500-E5 engines with 31,330 lb of takeoff thrust	
Rockwell Collins Pro Line Fusion Avionics System	
Gabbiano Tactical Radar T-20 from SELEX Galileo	
Cobham 900E Series Wing Air Refueling Pod	
Rafael Litening II electro-optical/infrared targeting pod	

Source: https://defense.embraer.com/global/en/c-390

INDUCTION: (LEFT) THE FIRST PRODUCTION AIRCRAFT WAS DELIVERED TO THE BRAZILIAN AIR FORCE (FAB) ON SEPTEMBER 4, 2019; (RIGHT) PRESIDENT OF BRAZIL, JAIR BOLSONARO CONGRATULATING BRAZILIAN AIR FORCE COMMANDER, LIEUTENANT-BRIGADIER ANTONIO CARLOS MORETTI BERMUDEZ ON THIS OCCASION.



PHOTOGRAPHS: EMBRAER, BRAZILIAN AIR FORCE

EMBRAER C-390 MILLENNIUM: A TIMELINE

2007

April 2007: The C-390 development programme was conceived.

2009

April 14, 2009 - Embraer was formally awarded a contract valued at $1.5 billion by the Brazilian government to design, develop and initially produce two prototypes for the FAB.

2010

July 2010: At the Farnborough Airshow, the FAB declared its plans to place orders for 28 C-390 aircraft.

August 24, 2010: The Defence Ministers of Chile and Brazil signed an agreement forthe National Aeronautical Company of Chile, ENAER, to participate in the project.

2011

April 2011: As per estimates made in April 2011 by the original equipment manufacturer (OEM) Embraer, there was a large market potential for this newly conceived platform as in their view, 695 military transport aircraft in service of the capability that was planned for the C-390

June 2011: At the Paris Air Show, Embraer announced plans to launch a stretched version of the C-390 in the year 2018.

December 14, 2011: Brazil and Portugal entered into an agreement for engineering components to be built by Embraer's Portuguese subsidiary OGMA that provides maintenance services and manufactures aero structures.

2012

April 2012: Embraer and Boeing signed a cooperation agreement in April 2012 which was upgraded in June that year into a partnership for further development and marketing of the C-390.

2014

October 21, 2014 - Embraer rolled out the first prototype of the KC-390 military transport from the production hangar at the industrial plant of Gavião Peixoto, Brazil.

As per estimates made in April 2011 by the original equipment manufacturer (OEM) Embraer, there was a large market potential for this newly conceived platform as in their view, 695 military transport aircraft in service of the capability that was planned for the C-390, would need to be replaced during the following decade. Another encouraging factor for the OEM was that in addition to the requirement projected for the C-390 by the FAB, several nations in South America had also expressed interest in this platform.

PROGRESS OF THE PROJECT

In August 2010, Argentina offered to participate in the building of the aircraft. On August 24, 2010, the Defence Ministers of Chile and Brazil signed an agreement for the National Aeronautical Company of Chile, ENAER, to participate in the project. In the same year, Colombia also signed an agreement to join the programme. On December 14, 2011, Brazil and Portugal entered into an agreement for engineering components to be built by Embraer's Portuguese subsidiary OGMA that provides maintenance services and manufactures aero structures.

Embraer and the US aerospace giant Boeing, signed a cooperation agreement in April 2012 which was upgraded in June that year into a partnership for further development and marketing of the C-390. In this partnership, Embraer held 51 per cent stake with the remaining 49 per cent held by Boeing. There was also a possibility for Embraer to set up a production line in the US that would considerably boost prospects of sale in the highly competitive global market. Unfortunately, as per an announcement by Boeing on April 25, 2020, this arrangement has collapsed. As per some reports, this development is likely to adversely impact prospects of sale of this aircraft in the global market. However, the impact is not likely to be as severe as is being projected as Embraer already has a strong presence globally with its regional jets and has an unblemished record.

December 20, 2017: The new Embraer KC-390 military transport and aerial refueling jet completed a relevant milestone, with Embraer demonstrating to the FAB, the attainment of the Initial Operational Capability.

September 4, 2019: The first production aircraft was delivered to the FAB.

April 25, 2020: Boeing announced that it has terminated its Master Transaction Agreement with Embraer, under which the two companies had sought to establish a new level of strategic partnership. The parties had planned to create a joint venture comprising Embraer's commercial aviation business and a second joint venture to develop new markets for the C-390 Millennium medium airlift and air mobility aircraft.

2015 **2017** **2018** **2019** **2020**

February 3, 2015 - Embraer successfully performed the first flight of the new military transport and aerial refueling jet, the KC-390. Test pilots Mozart Louzada and Marcos Salgado de Oliveira Lima flew the aircraft for 1 hour and 25 minutes, conducting an evaluation of flying qualities and performance.

October 23, 2018: The aircraft received a type certification from the Brazilian civil aviation authority, AgênciaNacional de Aviação Civil.

November 18, 2019: At the Dubai Air Show, Embraer announced the name and designation of its multi-mission medium aircraft, the Embraer C-390 Millennium.

June 29, 2020: Embraer delivered the third multi-mission medium airlift C-390 Millennium in the series to the Brazilian Air Force (FAB). The aircraft will be operated by First Troop Transport Group (1st GGT).

SCHEDULE FOR THE PROJECT

On April 14, 2009, Embraer was formally awarded a contract valued at $1.5 billion by the Brazilian government to design, develop and initially produce two prototypes for the FAB. In March 2010, Embraer came up with a schedule that laid down time lines for the development of this new platform. During the Farnborough Airshow in July 2010, the FAB declared its plans to place orders for 28 C-390 aircraft. Meanwhile, Embraer announced upgrade in the payload capability of the platform to 21 metric tonnes. Thereafter, in the following year i.e. 2011, at the Paris Air Show, Embraer announced plans to launch a stretched version of the C-390 in the year 2018. This announcement was related to the potential market in the civil domain where Embraer expected orders for up to 250 aircraft in the next ten years.

As per the schedule for development, the first prototype was slated to be delivered towards the end of 2014. However, there was a slight delay in the programme. The specified date of delivery could not be met with as the first prototype took to the air only in 2015. The delay of a year was not significant as in the overall perspective, the C-390 took to the air just eight years since the project was conceived – a notable performance by Embraer in the development of modern transport aircraft. On having logged 1900 hours of test-flying during its development phase, on October 23, 2018, the aircraft received a type certification from the Brazilian civil aviation authority, Agência Nacional de Aviação Civil. This civil certificate of airworthiness was formally awarded in a ceremony held at Brasília Air Force Base. The aircraft had already attained Initial Operational Capability (IOC) in December 2017.

The first production aircraft was delivered to the FAB on September 4, 2019 followed by the second. Embraer delivered the third aircraft to the FAB on June 29 this year and is required to deliver another 25.

LEADERSHIP DURING THE CEREMONY TO HAND-OVER THE FIRST C-390 TO BRAZILIAN AIR FORCE (FAB)

"It is an aircraft that arrived to add to the country and collaborate in the fulfillment of the Air Force mission," declared **President of Brazil, Jair Bolsonaro.**

"I am proud, not only as a Minister, but also with a Brazilian citizen, to participate in this moment", said **Minister of Defence, Fernando Azevedo e Silva.**

"Today, the largest military aircraft produced in Brazil, the KC-390 (now C-390), is incorporated into FAB. It represents a milestone in the excellence of FAB processes and will certainly boost the Defence Industrial Base in Brazil," said the **Brazilian Air Force Commander, Lieutenant-Brigadier Antonio Carlos Moretti Bermudez.**

"We are confident that the KC-390 (now C-390), in addition to successfully fulfilling the missions required by our Air Force, will have a positive economic impact on job creation and new investments in Brazil, as well as high value-added exports" said **Jackson Schneider, President and CEO of Embraer Defense & Security.**

PHOTOGRAPH: BRAZILIAN AIR FORCE

ROLES BEING PLAYED BY C-390 FOR HUMANITARIAN ASSISTANCE AND COVID-19 PANDEMIC RELIEF ACTIONS

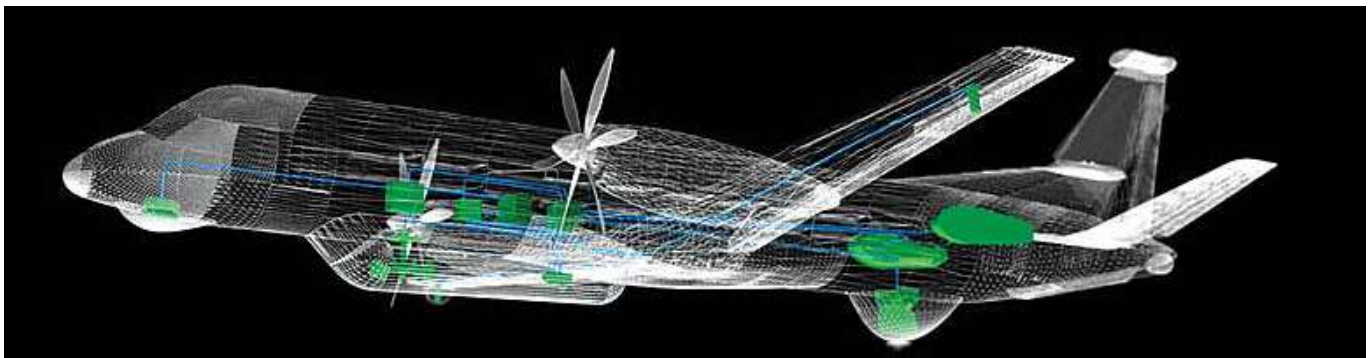
HUMANITARIAN ASSISTANCE

Two aircraft of the Brazilian Air Force (FAB) took off from the São Paulo Air Force Base (BASP) on August 12, bound for Lebanon in fulfillment of the mission of Humanitarian Assistance to the Lebanese Republic and landed around 3:40 pm on August 13, in Beirut, capital of Lebanon. The C-390 Millennium carried around six tons of medicines, food and health equipment for emergency care to affected families. The Embraer 190 VC-2 aircraft carried the official delegation, headed by former President Michel Temer. The C-390 Millenium, which performed for the first time an international mission manned only by FAB military personnel, belonged to the First Troop Transport Group (1st GTT) - Zeus Squadron, based in Anápolis (GO). The pilot of the aircraft, Captain Aviator Phelipe Machado de Souza, explained the versatility of the aircraft, "The C-390 has already been designed for this type of mission, as it has a large load capacity, range and autonomy"..

COVID-19 RELIEF

The Brazilian Air Force (FAB), in support of Operation COVID-19, carried out on August 16, Logistic Air Transport missions. The C-390 Millennium aircraft, belonging to the 1st Troop Transport Group (1st GTT) - Zeus Squadron, took off from São Paulo Air Base (BASP), in Guarulhos, with 10.8 tons of cargo, bound for Manaus (AM) and Boa Vista (RR). The items transported were used to deal with the Coronavirus pandemic. The commander of the aircraft, Lieutenant-Colonel Aviator Luiz Fernando Rezende Ferraz, highlighted the grateful satisfaction in being able to help the population in this moment of confrontation with the new Coronavirus. "Being able to take a large amount of material, with a Brazilian aircraft, is a unique moment and is part of the history of Brazil and the Air Force fulfilling the mission of integrating the national territory," he said. SP

Continued on page 29...



HENSOLDT'S "KALÆTRON" - ELECTRONICS SPECTRUM GAZING!

HENSOLDT SPECTRUM DOMINANCE AIRBORNE PRODUCT Portfolio includes three major EW domains (i.e. Electronic Support / SIGINT, Electronic Attack & Self-Protection) under the HENSOLDT Kalætron Brand.

HENSOLDT's Spectrum Dominance divison offers solutions not only for conventional and advanced electronic warfare but also for signal intelligence and cyber operations. Hardware development and artificial intelligence inside HENSOLDT electronics (æ) are core parts of HENSOLDT's future-oriented technologies at Spectrum Dominance.

Andleeb Shadman, *Managing Director, HENSOLDT Pvt Ltd, Head of Marketing & Business Development*, in an interesting conversation with Mr. Sergio Rizzi, *Head of Product Sales & Marketing Spectrum Dominance at HENSOLDT*, about Kalætron and its significance for Indian Market.

First of all, let me congratulate you for introducing Kalætron to the world in 2019 at Stockholm AOC EW Europe & Paris Le Bourget. May I request you to please explain to our reader about Kalætron?

Let me first tell you where does the name Kalætron (HENSOLDT Registered Trade Mark worldwide) come from - The ligature æ stands for "Artificial Intelligence inside HENSOLDT electronics", which not only categorises major functions of the system, but also serves as an important branding element.

The Kalætron is the product family offering tailored solution for Radar Warning Receiver (RWR), Electronics Support Measures (ESM), Electronics Intelligence(ELINT), Communication Intelligence (COMINT) either stand-alone or as a fully integrated systems depending on customer needs.

The architecture of Kalætron is highly modular and scalable having building block elements like innovative Digital Front End Receiver, Central Processor and different types of Antennas.

The Radar Warning Receiver is the first application, if you want, the "Zero Hour" for the Kalætron product family, which was extended by ESM and SIGINT applications under the "Kalætron integral" product family line and not long ago also complemented with Kalætron Attack, including the ECM core elements (AESA EW+ECM processor).

What is an edge of Kalætron system over competitor products?

I would highlight 3 important and unique propositions that Kalætron offers:

- Modular, scalable and platform independent architecture.
- Superior performance - Identification and classification of latest air defence threats having extremely wide bandwidth and/or hopping between particular frequencies in fractions of a second. Incredibly quick detection & identification of threats with a very low false alarm rate over an extremely wide frequency range.
- Collaborative Electronic warfare capabilities for future combined air operations. Kalætron Attack is a new addition to the Kalætron electronic warfare product family, which will include Escort Jamming, Stand-Off Jamming and Stand-In Jamming configurations. Kalætron Attack offers fully digitized technology for the entire chain of effects, from wide-ranging reconnaissance to distance-capable electronic combat, thus optimally fulfilling the requirements of an Electronic Combat role of any fighter aircraft.

How mature is Kalætron now?

Kalætron RWR as on date has successfully completed a severe phase of tests. The achieved results leave no room for doubts and confirm the absolute superiority of the cutting-edge solution made by HENSOLDT. We will report further in depth in due time with a dedicated press release.

Kalætron products were already introduced into the respective markets in 2019 with a dedicated premiere i.e. Kalætron RWR during Stockholm AOC EW and Kalætron Integral during Paris Le Bourget.

How do you see the Indian Market and what are your plan for it?

We believe that Indian armed forces have been undergoing rapid technological transformation to meet the ever expanding need of air superiority and Kalætron products would be real differentiator in terms of technological superiority and operational effectiveness either for retrofits / mid-life upgrade or for new platforms.

We see ample opportunities in India and we are in dialogue with key stakeholders to position different Kalætron products for respective platform needs as per "Make in India" directive of Indian government. SP

TRENDS IN ELECTRONIC WARFARE

The demand for EW systems will be driven by rapid technological advancements, focus on Directed Energy Weapons and the growing need for electronic protection capabilities

By AIR MARSHAL ANIL CHOPRA (RETD)

ELECTRONIC WARFARE (EW) IS ANY ACTION INVOLVING THE use of the Electro-Magnetic (EM) spectrum or directing energy to control or attack an enemy or impede enemy use of EM spectrum. The purpose of EW is to deny the opponent the advantage of and ensure friendly unimpeded access to the EM spectrum. EW can be applied from air, sea, land, and space by manned and unmanned systems, and can target humans, communications, radar or other assets, military and civilian.

TRENDS IN MILITARY EW

Modern warfare has made impressive strides in the areas of communications, radar and surveillance. Military Signal Intelligence (SIGINT) platforms are trying to cover the spectrum from HF to Ka band, sometimes over an enormous dynamic range. All efforts are on for improving EW technologies through means such as machine learning. While cognitive EW is a work in progress, the miniaturisation and density of electronics components continue to increase. If cooling technology keeps up, this will drive Radio Frequency (RF) system functional consolidation and enhance sensor performance.

The future will see multi-spectral, multi-mode and multi-function capability, said Chris Rappa, Product Line Director for RF, EW and Advanced Electronics with BAE Systems' FAST Labs Research and Development organisation. Active Electronically Scanned Arrays (AESAs) are already multi-mode but over a narrow band, he said. The aim is to build large or small totally digital arrays, where the electronics behind every element in the array, is digital and can be controlled in every aspect at the element level. A decade from now, Rappa expects to see very large, all-digital, precisely controlled arrays that are multi-function, multi-mode and capable of learning to be cooperative or disruptive as required. He expects they will be highly flexible, capable of SIGINT, Electronic Support Measures (ESM), Electronic Attack (EA), Radar positioning, Navigation and Timing (PNT) and communications, all from one array and one box, cognitively and adaptively controlled.

THE F-35 JOINT STRIKE FIGHTER CAN ALSO PERFORM EW MISSIONS

PHOTOGRAPH: USAF

EW systems will also become a lot smarter. Dan Kilfoyle, Technical Director for EW systems with Raytheon Space and Airborne Systems, expects future systems will be looking at more complex data sets, including in the context of signals.

MAJOR DRIVING FACTOR: GLOBAL EW MARKET

As per a Global Newswire report of December 10, 2019, increasing transnational and regional instability is a major driving factor for the growth of the EW market. This market, which was $25.813 billion in 2018, is projected to grow at a CAGR of 4.58 per cent from 2019 to 2026. The increasing rate of electronic, cyber, and optical domains will require a perceptible shift in war-fighting techniques. Since the avenues of technological advancement in these fields are limitless, new generations of equipment will emerge at a rapid rate. The challenge would be to integrate these into the physical domain of war-fighting and achieve the desired effect on the adversary. The relatively new field of Quantum Computing has the potential of creating a new generation of satellites.

GLOBAL EW MARKET 2020-2030

The demand for EW systems will be driven by rapid technological advancements, focus on Directed Energy Weapons and the growing need for electronic protection capabilities in militaries. There is greater emphasis on information superiority and situational awareness - a major factor driving spending in this sector.

As per a May 28, 2020 report in Business Wire, a Berkshire Hathaway company, the EW market is witnessing greater demand from airborne platforms leading to sustained investment in the airborne EW segment. There are increasing investments by most militaries in EW management systems, electronic jamming systems and other counter-measure systems.

INCREASED US EW ATTENTION

The US Defence Department plans to boost investment in

Continued on page 29...

AIR INDIA EXPRESS STRUCK WITH AN UNMITIGATED DISASTER

The airport at Calicut was upgraded to international status in 2006 and today it is the 11th busiest airport in the country in terms of traffic

By **AIR MARSHAL B.K. PANDEY (RETD)**

(LEFT TO RIGHT): MINISTER OF CIVIL AVIATION HARDEEP S. PURI INSPECTING THE CRASH SITE; THE PLANE FELL IN A GORGE 35 FEET DEEP AND BROKE INTO TWO; THE BROKEN FUSELAGE AND THE SCATTERED DEBRIS OF THE PLANE.

ON FRIDAY AUGUST 07 THIS YEAR, AIR INDIA EXPRESS FLIGHT IX 1344, a Boeing 737 airliner with 190 persons on board that was on a Vande Bharat Mission sponsored by the government to bring back Indian citizens stranded abroad, took off from Dubai for Calicut International Airport, Kozhikode in Kerala, ended up in a disaster at 1941 hours when trying to land at the destination airport. The airliner overshot the runway and fell into a gorge 35 feet deep on account of which, the fuselage broke into two pieces. The captain of the aircraft Deepak Vasant Sathe, the co-pilot Akhilesh Kumar, four members of the cabin crew and 14 passengers perished in the accident. Apart from these fatalities, over 100 passengers were seriously injured. The fact that the wreckage did not catch fire was indeed fortunate as if it had, possibly none would have survived the accident. This was the worst disaster that Air India Express has suffered since the loss of a Boeing 737 aircraft that overshot the runway while landing on the table top runway at Mangaluru airport and fell into a deep gorge killing all 158 on board. The difference was that the accident in 2010 was in the day time and in good weather whereas in the accident at Calicut, the landing was attempted at night time and in extremely adverse weather conditions.

Calicut International Airport, also known as Karipur Airport, is located in Karipur which is in Malappuram district of Kerala. The airport serves South Malabar region of Kozhikode, Malappuram, Palakkad and Wayanad.

PHOTOGRAPHS: HARDEEP SINGH PURI / TWITTER

WHAT LED TO THE ACCIDENT?

The Black Box which contains the Digital Flight Data Recorder (DFDR) and the Cockpit Voice Recorder (CVR), has been recovered from the wreckage and only after the data is retrieved and analysed by the Aircraft Accident Investigation Bureau under the Ministry of Civil Aviation, can the precise cause of the accident be established. As this will take time, here is an attempt in the interim to study and analyse the factors available in the public domain that could have led to the disaster.

LANDING IN ADVERSE WEATHER CONDITIONS

First and foremost is the prevailing weather conditions. With an active monsoon this year especially over Kerala, there was heavy rain accompanied by strong and gusty wind conditions in and around Calicut International Airport that has a table top runway 2,860 metres long. There are fairly deep gorges on both ends of the runway as also in some areas along the side of the runway. The orientation of the runway is 280 degrees/100 degrees, nearly East-West. As a landing is normally required to be carried out into wind to achieve a touch down at lower ground speed, given the prevailing wind conditions at that

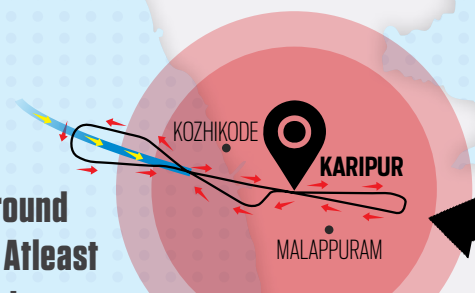
PLANE CRASH TRAGEDY

FLIGHT
IX 1344

PEOPLE ONBOARD
190

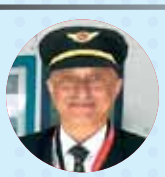
DEAD
18

Air India Express (AIE) Flight from Dubai with 190 people onboard overshot the tabletop runway at Kozhikode airport around 7:41 pm and fell 35 ft deep into a valley. Atleast 18 people were killed, including two pilots.



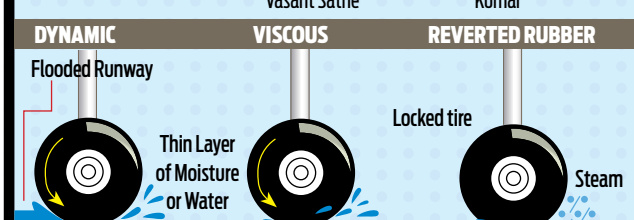
Path of the Air India Express aircraft minutes before it touched the ground at Kozhikode

COCKPIT CREW



Captain Deepak Vasant Sathe

Captain Akhilesh Kumar



When the runway is wet, hydroplaning can occur causing the tyre to slip on the water.

LOSS OF DIRECTIONAL CONTROL

As friction is reduced, braking effectiveness suffers and there is a threat of loss of directional control. Type pressure determines the speed at which hydroplaning may occur. **There are 3 types of hydroplaning:** Dynamic hydroplaning, Viscous hydroplaning and Reverted Rubber hydroplaning.

35 feet **DROP TO VALLEY**

The aircraft came amid heavy rain to land on runway 28 in heavy rain. But then it aborted landing and carried out a go-around. In their second approach to land, they attempted to land on runway 10. The tailwind was 15 knots.

2860 meters

ILLUSTRATION: SP GUIDE PUBLICATIONS / VIPUL

time, the first approach for landing was made by the pilot for runway 28 or the Westerly runway that offered the advantages of strong head wind. However, for some reason which will be ascertained from the CVR, the pilot was unable to execute a landing and carried out a missed approach procedure. Thereafter, the pilot in command decided to make a second attempt at landing, but this time from the opposite direction i.e. Easterly, for runway 10. However, in this attempt, the pilot made an approach for landing with strong tail wind conditions, reported to be around 15 knots, resulting in an overshooting approach and at significantly higher ground speed at the time of touchdown. The second attempt at landing was also abortive. In the third attempt on runway 10, on account of the strong tail wind, the float period got extended and the pilot in command managed to make the aircraft touch down at about 1,000 metres from the beginning of the runway. This left the pilot with just 1,860 metres in which he had to bring the aircraft to a halt.

On account of the heavy rain, the runway was waterlogged. While landing under these conditions, the "Braking Coefficient" is reduced significantly the aircraft is likely to experience "Aquaplaning", a phenomenon that is also known as "Hydroplaning". When this happens, the braking system of the aircraft becomes less effective with the Braking Coefficient even reducing to zero. Contact of the wheels with the runway surface reduces drastically resulting in locking of the wheels when the brakes are applied. As a result of this, the aircraft begins to skid with the pilot being unable to control further movement of the aircraft in respect of speed and direction. Under these conditions, brakes become totally ineffective and incapable of reducing the ground speed of the aircraft.

Thus after a touchdown at 1,000 meters from the beginning of the runway 10 and at significantly higher ground speed, the pilot in command was not able to stop the aircraft in the remaining length of the runway and fell into a gorge 35 feet deep after uncontrolled skidding past the end of the runway. It appears that having lost control of the aircraft on the landing run, the pilot foresaw what was coming and possibly shut down both the engines thus obviating the possibility of the wreckage catching fire. The low rate of fatalities in an accident of this kind, can possibly be attributed to this action by the pilot. But what is more intriguing is why the pilot could not manage a successful approach and landing on runway 28 where he would have had head wind conditions. What also needs an answer is as to why the pilot chose to make an approach for landing on runway 10 where he encountered strong tail wind conditions. And more importantly, as per the company policy, the pilot was required to divert to another airport with less severe weather conditions; but he did not choose to do so. There were a number diversionary airfields with less severe weather conditions available for the pilot to choose from such as Kannur, Cochin, Trivandrum, Mangaluru or even Bengaluru. Answers to the question as to why the pilot did not opt to divert will be found in the CVR which will also reveal the communication between the aircraft and the Air Traffic Controller on duty.

TABLE TOP RUNWAY

There are several table top runways across the world including three in India. For operating from table top runways, appropriate training for skill development and formal clearance is required for each runway as these have inherent characteristics and hazards that are not common to all. Operation from table top runways can also be very challenging as these offer very little margin for error. Prior to the crash on August 07, the Calicut airport had recorded four accidents. On August 04, 2017, a SpiceJet flight had skidded on landing and damaged the ILS beacons. The same year on April 25, an Air India flight suffered an engine failure during takeoff leading to a left tyre burst. On July 09, 2012, an Air India Express skidded on landing, again during heavy rain. On November 07, 2008, Air India flight from Jeddah had scraped the runway with its right wingtip while landing.

In the case of Calicut airport, the height of the table top runway is only 35 metres. Another limitation of this table top runway is that the Runway End Safety Area (RESA) which caters for overruns, is less than then the prescribed figure, causing a potential safety hazard. There was talk of extending the runway to 3,000 metres and the RESA to the required length, but as the runway is located on top of a hill, it would involve enormous effort and investment to create extra land at that height at both ends of the runway.

> Following the accident at Mangaluru airport in 2010, a number of improvements were suggested, but these are yet to be implemented

The airport at Calicut was upgraded to international status in 2006 and today it is the 11th busiest airport in the country in terms of traffic. Following the accident at Mangaluru airport in 2010, a number of improvements were suggested, but these are yet to be implemented. There is a standard operating procedure (SOP) laid down by the Directorate General of Civil Aviation for removing water from the runway. As to whether or not this SOP was followed at Calicut International Airport in this case, will be known after the investigations are over.

PROFESSIONAL CREDENTIALS OF THE PILOTS IN COMMAND

Captain Deepak Vasant Sathe, the captain of the ill fated Air India Express flight, had joined the National Defence Academy as an Air Force Cadet and was commissioned into the Indian Air Force (IAF) as a fighter pilot in June 1981. He served with No. 17 Golden Arrows Squadron that is now being reequipped with Rafale jets. Deepak Sathe was also trained as a Test Pilot in the IAF. While serving as a fighter pilot, he was involved in flying accident in the early 1990s in which he suffered serious head injury. However, due to his strong will power and passion for flying, he successfully returned to military flying. He took premature retirement in the rank of Wing Commander after 21 years of service and migrated to civil aviation. He joined Air India in 2013. Captain Sathe was undoubtedly endowed with outstanding professional credentials.

Akhilesh Kumar, the co-pilot of the ill fated Air India Express flight, began flying with Air India in 2017 and was the first officer of the Air India Express flight in May, which was the first repatriation flight under the Vande Bharat Mission to land in Kozhikode, bringing back stranded Indians in Dubai. He had a total flying experience of 1,723 hours. SP

FIA GOES VIRTUAL

MANY MORE FIA STORIES ON:
HTTP://WWW.SPS-AVIATION.COM/FIA-CONNECT/

By AYUSHEE CHAUDHARY

One of the largest trade exhibitions for the aerospace and defence industries, where civilian and military aircraft are demonstrated to potential customers and investors, the Farnborough International Airshow went online

TEMPEST: THE NEXTGEN COMBAT FIGHTER IS A FUTURE COMBAT AIR SYSTEM (FCAS) FOR THE ROYAL AIR FORCE (RAF) AND OTHER EUROPEAN AIR FORCES AND FOR EXPORT. THE UK'S FCAS IS A £1.9-BILLION PROJECT TO DEVELOP THE NEXT GENERATION COMBAT AIRCRAFT WHICH WILL REPLACE THE TYPHOON.

PHOTOGRAPH: BAE SYSTEMS

THE GLOBAL PANDEMIC OF CORONAVIRUS MIGHT HAVE brought some unprecedented situation and new challenges but it has not dampened the spirits of those who are determined to deliver especially in the aviation industry. One of the largest trade exhibition for the aerospace and defence industries, where civilian and military aircraft are demonstrated to potential customers and investors, the Farnborough Airshow, officially the Farnborough International Airshow (FIA) went online for the first time.

Under the name of FIA Connect, there were a series of virtual events taking place during the week of what would have been the FIA. The organisers aimed at having five days of high quality content, collaboration, thought leadership and industry insight; connecting the global aerospace industry online to bring the industry together and provide a platform for debate, business updates, and networking in the absence of this year's cancelled summer gathering.

From space exploration to sustainability and environment, from infrastructure to innovation, from investment to trade relations as well as announcements, spotlight sessions and various panel discussions, the FIA Connect programme was a summit of significant discussions with over 248 visitors, 58 speakers, 32 sessions, 14 exhibitors and 18 media from Europe, Asia, the Middle East, South America and the USA. SP

FROM FUTURE ADVANCEMENTS TO PRESENT SURVIVAL

☐ **Ayushee Chaudhary**

▲ PANELISTS DISCUSSED THE TECHNOLOGICAL NEEDS, COVID-19 IMPACT ON AIRLINE TRAFFIC, ADJUSTED DEMAND FOR AIRCRAFT PRODUCTION AND HOW THE 737 MAX WILL CHANGE AIRCRAFT CERTIFICATION SCRUTINY.

AS FOR LEANN RIDGEWAY, VICE PRESIDENT of Avionics and General Manager of Information Management Services for Collins Aerospace, technology can play a significant factor in the recovery. "In the airport environment, biometrics present an easy solution to reduce touch points and congestion. Other areas to help in the airport include the use of kiosks to minimise the use of cash, increased use of mobile applications to help ease congestion points, and the deployment of artificial intelligence to help in the gate areas to minimise exposure risks. Research further centers on ultraviolet technologies in the airplane to help kill harmful pathogens, but more needs to be explored on the effects on passengers and airport materials," Ridgeway said.

Panelists from Air Lease Corp., Embraer and Emirates also discussed about the technological needs within the next generation of commercial airliners. Including COVID-19's impact on airline traffic, adjusted demand for aircraft production and how the 737 MAX will change aircraft certification scrutiny and regulation moving forward, there were also talks of what technologies could be incorporated into the next generation of commercial airliners, such as advancements in engine propulsion and interior innovation.

"In the short term, frankly I don't see too much change. I see less players, and I see a risk averse nature of boards and shareholders in both the manufacturing and the airline community," said Emirates President Tim Clark. "Give it three or four years - let's also have a look at how we go about dealing with the environmental aspect, which is a really good thing to happen to all of us because it's making us really think hard about what we need to do," he added.

Steve Udvar Hazy, Executive Chairman of the Board for Air Lease Corp., also believes that the airline industry will need to show at least another three to four years of stabilisation before manufacturers can start introducing next generation concepts because the current demand simply is not there for them. COVID-19 has introduced the "greatest step change in production outlook in the last 30 years".

Air Lease Corp. provides leasing services for a total of 111 commercial airlines, most of whom operate Airbus, Boeing, Bombardier and Embraer aircraft. However, Hazy believes that industry disruption will come from outside of the traditional names and instead be generated by newcomers. He also thinks the disruption in design concepts is not going to come from Airbus and Boeing. I think it's going to come from smaller innovative players.

COVID-19 has changed the commercial side of the aviation industry's focus from making technological advances to surviving

PHOTOGRAPH: SJAE

the current environment and preparing for the future, experts agreed.

"Engine propulsion advancements are an area where I see limited expansion in the near term as well. Current engine technology cannot be anymore pushed into double digit gains. I think this last round of turbo fan technology – unless you go to an ultra-fan concept – there's no way to get double digit fuel gains. The other problem I see is when you increase the capital costs of these airplanes substantially; it offsets the gains on fuel burn. If you can achieve a 10 per cent fuel burn advantage, but the airplane is 40 per cent more expensive than the airplane it is replacing, you lose the economics of that fuel burn advantage. I'm looking forward to disruptors that will come up with new concepts which the OEMs can then latch onto," Udvar Hazy said.

When considering what the next generation single aisle airliner could look like, Udvar Hazy said that some improvements to fuselage designs such as increasing aisle width and improving the onboarding and off boarding process could help to create a more user friendly passenger experience.

Boeing's New Mid-Market Airplane (NMA) was also a topic featured on the panel. The NMA was a next generation mid-range airplane that the company had been rumored to be developing as a replacement to the 757 and a competitor to the Airbus A321XLR for several years before shelving the programme in January to focus on returning the 737 MAX to service.

Arjan Meijer, who was appointed President and CEO of Embraer Commercial Aviation on June 16 pointed out the current high utilisation rates of Embraer's regional jets as international flying has been limited by border restrictions. "Our segment is more in demand than ever if you look at the airlines around the world, they're using E-jets. E-jets were parked a lot less than narrow bodies and if you look today at how many E-jets are flying in China, in Europe, in Africa and North America – they're all coming back," Meijer said.

Despite the COVID-19 pandemic's impact on aircraft demand, Meijer said that the company is still keeping innovation in focus for the near future, although the ground-breaking technologies such as electric hybrid propulsion will be limited to smaller scale aircraft. SP

TEAM TEMPEST EXPANDS FOR THE NEXT GENERATION COMBAT AIRCRAFT

General Electric UK, QinetiQ, Collins Aerospace, Thales, Martin-Baker, GKN and Bombardier come on board the Team Tempest, a future combat air system being developed for RAF & other European forces

☐ **Ayushee Chaudhary**

UNITED KINGDOM SECRETARY OF STATE FOR DEFENCE BEN Wallace confirmed during the FIA Connect event that seven new companies had signed agreements to collaborate on the Team Tempest, which is said to be developing a future combat air system (FCAS) for the Royal Air Force (RAF) and other European air forces and for export.

The United Kingdom (UK)'s FCAS is the £1.9-billion project working to develop the next generation combat aircraft, known as Tempest, which will replace the Typhoon. Launched in 2018, Team Tempest is a group of industry partners working in collaboration with the UK's Ministry of Defence (MOD) on FCAS project.

The alliance is quickly gaining recognition for its work and notched up a world's first within two years of launching by designing a generator that delivers unprecedented levels of electrical power.

"I'm delighted seven more companies have joined this mission to work in collaboration with the MOD, under the Team Tempest banner. They will bring the ambition, invention and expertise that will deliver the breakthroughs we will depend on for decades to come. These pioneers will strengthen our ability to develop a next generation aircraft and allow us to continue making vital contributions to UK, European and global security," said Wallace.

UK's Defence Minister Jeremy Quin said, "The announcement demonstrates further progress in delivering the UK's combat air strategy, with more companies collaborating on the future of the UK's Air Defence. This is a highly innovative project based around cutting-edge technology and drawing on a skills base where the UK excels."

Since its creation in 2018, Team Tempest has already employed more than 1,800 highly skilled engineers and programmers. Set to increase to 2,500 by next year, the programme is securing the UK's position as a global leader in combat air.

"The companies who have signed a partnership are General Electric UK, QinetiQ, Collins Aerospace, Thales, Martin-Baker, GKN and Bombardier. The addition of these seven new firms would be bolstered by contributions from small-to-medium enterprises (SME's) and universities that are also involved in the development effort," Wallace added.

The new members of Team Tempest will join forces on established projects and development work with core members BAE Systems, Leonardo UK, MBDA UK, Rolls-Royce and the Ministry of Defence, bringing the best of British expertise and ingenuity on designing, manufacturing and operating combat air systems, the UK government stated.

Announcing the new Team Tempest partners Wallace also said, "At Farnborough 2018 we unveiled our plans to deliver FCAS (Future Combat Air System) and strengthen our military capability with the formation of Team Tempest. Two years on I am proud to announce that that vision is becoming a reality. Over the next five years, I can announce we will be testing out a suite of new novel concepts that are likely to form our Future Combat Air System." Quin further acknowledged that the success and strengths of Team Tempest are being enhanced through drawing on UK expertise; working with industrial partners and highly capable international team we are configured for future success. "Together the companies will develop more than 60 technology prototypes and demonstration activities. New processes will also deliver technology and intellectual property in half the time and at significantly lower cost than previous complex combat air programmes," he added.

Wallace also stated that at present the RAF fleet is made up of a mix of around 90 per cent manned and 10 per cent unmanned aircraft and by 2040 he expected to see a 'major reversal of these proportions'.

The seven companies join British, Italian and Swedish firms already working on the project led by the Royal Air Force's Rapid Capabilities Office building on the existing industry team of Rolls-Royce, BAE Systems, Leonardo and MBDA.

Wallace said: "There is a real opportunity here, not just because of the technological spin-offs that will inspire the wider civilian sector, not just because of the boost we are giving our UK skills base, but because of the potential we have to break into lucrative global markets."

The UK is keen to see more international partners get involved with the programme as a chance to share technology, experience and R&D costs, to strengthen existing alliances, and help establish new ones, Wallace pointed out. The resultant aircraft of Team Tempest will replace the in-service Eurofighter Typhoon and serve in the RAF alongside the Lockheed Martin F-35.

GLOBAL PARTNERSHIP ON FUTURE COMBAT AIR CAPABILITY ADVANCES

This announcement came on the same day as SAAB announcing, it is opening a £50m centre in the UK for the development of Future Combat Air Systems. "Saab took the decision to create a new FCAS center so that we can further develop the close working relationship with the other FCAS industrial partners and the UK MOD. This emphasises the importance of both FCAS and the United Kingdom to Saab's future," said Saab's President and CEO, Micael Johansson.

Sweden had formally joined Team Tempest in 2019, with Saab leading Swedish industrial involvement with the UK-led programme. UK, Sweden and Italy have also started trilateral industry discussions to enhance collaboration between the three nations to develop world-leading future combat air capability.

The new trilateral framework sees industry from the three nations bringing together their skills and expertise in the combat air sector to collaborate on the research and development of cutting-edge technologies, stated BAE Systems.

Charles Woodburn, Chief Executive Officer, BAE Systems said, "International partnering provides the best opportunity to deliver a capable, flexible and upgradeable combat air system. We've made good progress with Saab and Leonardo in identifying shared goals and expertise and through this new framework, we can build on this collaboration to unlock the huge potential across our three nations."

The three national industries comprise leading defence companies from the UK (BAE Systems, Leonardo UK, Rolls-Royce and MBDA UK), Italy (Leonardo Italy, Elettronica, Avio Aero and MBDA Italia) and Sweden (Saab and GKN Aerospace Sweden).

Alessandro Profumo, Chief Executive Officer, Leonardo, said, "All three national industries fully grasp the historic nature of this moment. Tempest will be the cornerstone of a cross-border system of common defence which will extend far beyond combat air. It will secure enormous economic benefits and vast industrial and technological progress for Italy and our partners. Together, we share an understanding that if we get this right now, our respective aerospace and defence industries will thrive for a generation."

Together, the companies aim to assess common routes to future combat air capability using their know-how, expertise and technology development activities across current and future combat air systems.

Saab's Johansson said, "Combat Air is a key component of Sweden's defence policy and it is defined as a national security interest. Saab is therefore taking these important steps to remain at the forefront of System of Systems development and the advanced technologies within Combat Air. We welcome the leadership by the Swedish and UK government and are pleased to deepen our relationship with Italian industry."

The UK has existing co-operation with Sweden and Italy. All three nations' industries and militaries are partners in the joint development and operation of the Meteor beyond visual air-to-air missile that is arming Gripen, Eurofighter Typhoon and F-35. SP

FIA DRAWS FOCUS ON THE ELECTRIC FUTURE OF AIR MOBILITY

While the concerns around infrastructure and people's beliefs still remain, the industry experts are confident about the potential of UAM which will takeover transportation in the times to come

DESIGNED WITH REGIONAL MOBILITY IN MIND, LILIUM JET AIMS TO BALANCE COMPETING REQUIREMENTS FOR RANGE, SPEED AND PAYLOAD WHILE DELIVERING A LOW NOISE FOOTPRINT AND SAFETY. ▶

PHOTOGRAPH: LILIUM JET

☐ **Ayushee Chaudhary**

EVER SINCE THE TALKS AND TESTING OF UNMANNED AIR vehicles started, the future of air mobility has gained excitement and interest from all across the globe. From start-ups to established manufacturers, everyone has been gearing up to come up with unmanned vehicles and redesign the urban air mobility (UAM) picture. Talks about UAM vehicles and how they are going to bring aviation to the masses are all around the industry but how will this new style of transportation work for a large segment of the population, still remains a question. During FIA Connect some answers and developments about the future of air mobility were discussed through multiple panel discussions and sessions so as to throw light on the journey of 'demo to do'.

The sessions also discussed that while start-up companies enjoy an advantage in developing the disruptive technologies driving the UAM revolution, there is still a crucial role to play for the incumbent aerospace industry giants.

THE PANDEMIC AS AN OPPORTUNITY FOR UAM'S POTENTIAL

The COVID-19 pandemic has affected the development in the UAM sector much like in any other sector. However, many see that as a

positive because it has ushered in a new era of for change and an acceleration of its implementation. Moreover, regulatory flight waivers during the crisis have allowed development to be undertaken more freely with regard to flight-testing. COVID-19 has also given some companies a chance to demonstrate the benefits of electric aviation. China's EHang, for instance, has been using its autonomous air vehicles to deliver medical supplies and personnel to hospitals during the crisis.

Boeing Next's vice president and general manager Steve Nordlund said during a session, "Limitations caused by social distancing due to the COVID-19 pandemic have changed the way people shop and how deliveries are received. UAVs can also be used to deliver urgent health care and medications to people safely, even in remote areas and in the aftermath of natural disasters. I think all of that is going to emerge as a potential opportunity in a way that adds a whole new dimension to how aviation systems."

However, this may or may not be a blessing in disguise for the sector as a whole. Many others in the industry consider that those with more mature, more consortium-driven user cases appear most likely to find traction.

Some speakers also raised concerns that Covid had introduced uncertainties, mainly at the societal level. The nature of the "workplace" and that of business travel in the future is far from certain, nor are the best uses for electric aviation. Local authorities might not consider short-range, intra-urban travel as attractive a proposition as using electric vertical take-off and landing (eVTOL) machines to bring commuters into the city from outlying areas to relieve some of the burden on ground transportation.

According to the management consultancy Roland Berger, more than 1,60,000 small, remotely-piloted passenger aircraft will be in service in congested cities around the world by 2050. And while the coronavirus outbreak may delay many eVTOL developments over the next months and years, the firm expects it to have little long-term impact on the growth of the UAM market.

ELECTRIC IS THE WAY FORWARD

Speaking at the Global Urban Air Summit (GUAS) at FIA Connect, Roland Berger's UAM project leader Stephan Baur stated nearly 70 per cent of the world's population will live in cities and towns by 2050, with population size expected to outstrip ground transportation capacity by over a third.

Technology is moving so quickly, it may not be long until everyday flight becomes feasible through the power of the platform that Uber brings through its huge network of demand, said Eric Allison, head of Uber Elevate while emphasising his company's commitment to UAM, having started on this challenge three years ago.

Uber Elevate's Allison also gave his reasons as to why the future is electric by stating, "We've come to the pretty strong conclusion that all electric is actually the way to go, right out of the gate. The reason for this is that it's actually interesting ripple effects and consequences of what you choose in terms of power. It's effectively designing a system of systems that the service is the product – it's not the airplane itself. And so we have to think about the implications on infrastructure siting, infrastructure permitting, costs of building an infrastructure and how that effects the economics of the overall service."

Honeywell's Senior Director, Strategic Planning, UAM, Jia Xu, also seconded the belief for the electric future. He said, "We have a vision that the future of air cargo will be completely autonomous, from warehouse to your house and urban air travel will be ubiquitous and accessible with electrified and highly autonomous aircraft. And that's why we're building innovative propulsion and avionics systems for UAM and UAS to make that future a reality."

Xu also added that there certainly are benefits, but not without challenges. Unit economics would need to be improved with UAM vehicles carrying less passengers and parcel delivery fulfilment centres would need to be developed for occasions when a pilot couldn't physically fit into an aircraft.

UAM technologies are also finding extension in space through NASA as well as in defence. NASA's vision of UAM is a safe and efficient air transportation system where everything from small package delivery drones to passenger-carrying air taxis operate above populated areas.

The US Air Force is also pursuing UAM technologies and is eager to help develop such platforms. "There is so much more innovation happening outside the government. We have to get outside our walls and where innovation is happening. UAM is on the cusp of flying us around as the Jetsons promised in 1962. When we look at UAM and what a big impact that could be for the economy, the Air Force cannot stand by idly and hope the market evolves. We think we can be some of the first adopters of this technology," said Will Roper, US Air Force assistant secretary for acquisition, technology, and logistics.

Roland Berger even expects the 1,60,000 eVTOLs by 2050 to be spread equally across three defined market niches:

- The first group will be city taxis – on demand point-to-point flights from any available landing pad or vertiport within a defined area. The aircraft for this market would mostly be designed to carry up to two passengers and their light luggage for a distance of between 15 km to 50 km.
- The next category will be airport shuttles – scheduled short-haul operations connecting landing pads with an aerodrome. These routes will be served by eVTOLS carrying mostly up to four passengers between 50 kg to 80 kg of luggage.
- The third would be inter-city flights, which are described as scheduled services connecting two conurbations that are not served by a regular commercial service. Aircraft serving this niche will carry over four passengers on distances of up to 250 km.

Roland Berger also expects a step-by-step introduction of UAM. "In the early years when volumes are small and costs high, it will be introduced as a high-price, exclusive service to say business executives mostly," said Manfred Hader, Roland Berger's senior partner, aerospace and defence. "As we go down the learning curve, and the scale of the operations increase, we will see the transition to a premium public transportation means, where UAM services will be comparable with taxi services in terms of cost," he further added.

REGULATORY REQUIREMENTS

Efforts need to center on regulation, capital, and timing, and if any of those factors do not happen in proper sequence, the market will not develop properly. "So when the vehicles are ready, the infrastructure is coming on line, and the regulations are in place, then they can operate in a commercially relevant way," added Allison.

Michael Romanowski, director of the FAA's (Federal Aviation Administration) Policy and Innovation Division, representing the US agency said, "Being the regulator, it is my job to look out for the safety of the system and the vehicles that will operate in the UAM environment." The FAA is now working with 30 companies in its Innovation Center to help them on the path toward certification of their UAM vehicles. But certification is only one step. Helping the public understand the safety of such vehicles will be another important factor.

▲ UBER ELEVATE AIMS TO TRANSFORM COMMUTE THROUGH AERIAL RIDESHARING BETWEEN SUBURBS AND CITIES, AND ULTIMATELY WITHIN CITIES

PHOTOGRAPH: UBER ELEVATE

COMMUNITY CONCERNS & INFRASTRUCTURE ISSUES

However, before operations can begin, the UAM developers still have to overcome several barriers. Romanowski highlighted that when he speaks with local community groups, their big concern is whether UAMs will be flying over their houses. It is important to communicate, he explained, and "make sure the community understands. We can make the vehicles quiet, but where will they fly? The most likely routes will be over freeways, mimicking how helicopters operate, but eventually as people realise how quietly UAM vehicles operate, random programming could be used to create routes that only occasionally fly over a particular home."

To gain the trust, technology on these new platforms must be mature, safe, and properly certificated for airworthiness, the speakers discussed.

While the focus is now mainly on the vehicles themselves, the question of infrastructure is increasingly becoming the main topic as teams build their businesses. That presents obvious issues such as vertiports, communications, and air traffic management. The question of whether UAM is considered as mass transport available to all, or a high-premium service for the few, is yet to be answered. This question also has a bearing on social and political acceptance at a local level. The discussions also pointed out that it seems unlikely that governments would commit large investments to UAM infrastructure, leaving a void for the private sector to fill.

Nevertheless, following a number of studies underway on a city-by-city basis, the question of infrastructure is now beginning to be tackled at an active level, with investment imminent to lock up properties that are ideal for vertiports in the most promising cities.

As UAM is a completely new mobility system, much of its promised convenience will depend on how seamlessly it integrates with the existing transport network – air, rail and road. This will not only require a rethink of the mobility chain and services, but will also require investment in additional infrastructure such as vertiports, Hader said. He further added that it also raises the question about what are the best location for these landing sites and what will they look like.

Not just that, UAM also needs a clear and convincing business case to show that it is commercially viable and can attract the necessary funding to scale up. Hader also highlighted that, "The industry must show that eVTOLs actually fly, and what they are really capable of. This in turn will spur the public's imagination and appetite for UAM services, which in turn will rally the support of authorities and investors."

"You have to have that collaboration with that fast, disruptive thinking not bounded by pre-conceived notions that might exist in a 104-year old company. But how do you bring and accelerate development when you get to the tough things of certification, regulation, and even manufacturing? It's bringing the best of both worlds together," stated Brian Schettler, senior managing director with Boeing HorizonX.

While speaking for the first virtual FIA, Lilium's Chief Operating Officer, Remo Gerber said, "Many people hear about urban mobility today and they are thinking flying from one part of the city to the other. We do not have our belief that this is where this whole industry is going to start. We, of course believe in flying inter-city and in connecting city centres to other city centres but the biggest goal we set ourselves is to save time for our customers and for that you do need a certain minimum distance for a first mile and the last mile transfer to really make sense and to create that time gain." Gerber highlighted three ways that Lilium is really focusing on for that.

- One is the range of the aircraft to connect cities as far away as possible and really create that time gain. However, the side effect of that is this range since the batteries can be recharged on shorter distances.
- Secondly is around the speed which can very effectively create time gain from one inter-city to another inter-city.

Continued on page 27...

PANDEMIC DELAYS PRODUCTION, YET LOCKHEED MARTIN AIMS TO ACHIEVE F-35 DELIVERY TARGET

The F-35 production line has delivered 540 aircraft, and more than 1,000 pilots and 10,000 maintainers are now trained to fly and work on the aircraft

▲ LOCKHEED MARTIN'S F-35 IS BELIEVED TO BE ONE OF THE LARGEST GLOBAL DEFENCE PROGRAMMES CURRENTLY UNDER WAY IN THE SUPPLY CHAIN TIERS.

☐ **Ayushee Chaudhary**

WITH A WIDE RANGE OF SUPPLIERS FROM DOMESTIC TO international, the Lockheed Martin F-35 is considered as one of the largest global defence programmes currently under way in the supply chain tiers. The F-35 production line has delivered 540 aircraft, and more than 1,000 pilots and 10,000 maintainers are now trained to fly and work on the aircraft. Eight countries have F-35s operating from their territories, and six services have declared initial operational capability (IOC).The US Air Force, Navy and Marine Corps are buying different variants of the aircraft. The programme also includes eight international partner nations and five foreign military sales customers. Lockheed Martin, the prime contractor, hopes to eventually sell more than 3,000 platforms worldwide.

However, like the large impact that COVID-19 has had on industries worldwide, the pandemic has also affected the production rate of F-35. Lockheed Martin's Vice President of F-35 production, Darren Sekiguchi said during an FIA Connect session that F-35 delays of two to three months are further expected before the production rate can return to pre-COVID-19 rates by hopefully the late summer or early fall this year. "At this time, we expect to see impacts of 18 to 24 aircraft in 2020. However, we will accelerate production when we return to pre-COVID-19 conditions to recover as many delayed aircraft as possible. This year's delivery target is 141 aircraft, and we continue to work towards that goal."

Lockheed Martin designed the F-35 production system to be as flexible and resilient as possible so that alternative sources can cover single-point supply problems, but the worldwide effects of COVID-19 have inevitably affected the supply chain, Sekiguchi added.

To maintain its major defence contractors and their key programmes during the crisis, the US government introduced an accelerated programme payment scheme that released more than $1 billion in F-35 payments to Lockheed Martin, all of which has cascaded into the supply chain to ensure that it remains intact.

Meanwhile, the aircraft continues to expand its capability and is currently undergoing a programme known as Tech Refresh 3, which provides additional computer capacity, informed Santi Bulnes, Vice President of F-35 engineering and technology. "That computational capability allows us to have additional new software modes, to be able to use new information and fuse it in different ways from the sensors. It will enable interoperability, new datalinks, and the connectivity that is so important in the modern warfare world. All those things will be enabled by that additional throughput," he said during the session.

New weapons are also coming, highlighted Bulnes while adding, "We are going to be easily adding upwards of 20 new weapons over the next few years. That gives the warfighter the flexibility needed when they go into theater. Not only can they penetrate where others can't, but they'll have the right weapons to do it. The automatic ground collision avoidance system, which has been operational in the F-16 for some time, has proved an important addition from a safety standpoint. We have been able to pull that capability up five years early with our new software processes on the F-35," said Bulnes.

The upgradation of the aircraft's data information system, which lies at the heart of logistics, maintenance, training, operations, and technical support planning is one of the most important upgrade. The original Autonomic Logistics Information System (ALIS) design emerged in the mid-2000s and has not benefitted from any technological refreshes, although it continues to receive updates on a quarterly basis. Hence to replace it, a Joint Program Office-led team has developed the Operational Data Integrated Network (ODIN), to leverage the huge advances made in digital technology over the last decade and create a system that can handle far more data. ODIN is expected to reach full operational capability in 2022.

The price tag for the fifth-generation aircraft has long been a concern for acquisition officials and lawmakers. In recent years, Lockheed and the F-35 Joint Program Office have worked to drive that down. The procurement cost of the F-35A is now about $80 million per unit, making it more competitive with legacy aircraft.

"We continue going after the O&S cost of the aircraft. That is very high," said Stephen Sheehy, Lockheed's vice president for sustainment business development. However, he noted that over the past five years there has been a 38 per cent decrease in the operations and sustainment costs that Lockheed Martin is responsible for. A further reduction of 50 per cent is expected in the next five years, he said.

The company also estimates that it controls 39 per cent of the programme's O&S costs, with other programme partners responsible for the rest. Lockheed executives say they are working with the US government to achieve similar savings on the remaining 61 per cent, with the goal of lowering the cost per flying hour for the F-35A to $25,000 by 2025. The company has also proposed making a $1.5 billion upfront investment in performance-based logistics, which would save F-35 customers $1 billion over the first five years of the deal and $18 billion in savings by 2040 if that work continues, Sheehy noted. SP

PHOTOGRAPH: LOCKHEED MARTIN

FIRST EVER VIRTUAL AIRSHOW CONCLUDES SUCCESSFULLY

With approximately 14,000 delegates coming together across countries and continents virtually, the FIA Connect successfully deliberated on sustainable and crucial matters of the aviation industry

▲ ONE OF THE LARGEST AIR SHOW IN THE WORLD, FARNBOROUGH INTERNATIONAL AIRSHOW, WENT VIRTUAL THIS YEAR.

☐ **Ayushee Chaudhary**

CARRYING FORWARD ITS HISTORY OF FIRSTS, THE Farnborough Air Show successfully concluded a virtual airshow under the FIA Connect. This was one of the world's first major digital trade events for the aerospace and defence industries and delivered a week of qualitative content and significant representation from government and business.

Nearly 14,000 delegates came together virtually from 97 countries. Over five days, 240 representatives including from names like Boeing, Airbus, Leonardo, Rolls-Royce, BAE Systems, Emirates, etc. contributed to the conference programme.

"Farnborough has an enduring reputation for technological ingenuity and through FIA Connect, our team demonstrated an ingenuity of our own. In just a matter of months, we created an event that enabled the global aerospace industry to have vital conversations at a time it is enduring the biggest challenge in its history," said Gareth Rogers CEO of Farnborough International. He believes that FIA Connect will serve as a landmark event which ensured Farnborough International continued to provide a strategic platform for organisations throughout the world to come together even during a time when we cannot meet in person.

In addition to the conference programme, many buyers also met suppliers as part of the week's Meet the Buyer. The Global Urban Air Summit (GUAS) 2.0 provide platform for industry engagement in the innovative, exciting and growing urban air mobility sector. FIA Connect concluded with Farnborough Friday: day dedicated to inspiring young people and engaging them in the wealth of career opportunities available throughout the industry.

From sustainable flights to unmanned vehicles, commercial to defence to space, careers in aerospace to the future and the women in aviation, the FIA Connect offered something for everyone.

Thousands of aviation industry professionals virtually connected for the Airshow and reflected upon the Covid-19 pandemic majorly among many other significant topics. The online FIA event became an opportunity for industry stalwarts to come together and speak about the changed scenario due to the pandemic, the steps that must be taken and what the future might hold.

The airshow might not have seen the dynamics of different deals taking over because of the situation that the industry is in but it did see a significant amount of collaboration and thought process being constantly undertaken by the industry. SP

AIR MOBILITY... *Continued from page 25*

- Last but not the least is the noise. Lilium aims to create an aircraft as quiet as possible, six to seven times quieter than a helicopter so it can fit into existing city noise environments and also more specifically, also use the sort of arteries that connect the city's motorways, train lines, rivers to create almost like the perfect combination for not bothering the people that live there and still connect them with an aerial service.

The consultancy also stated that with a forecast requirement for about 2,00,000 vehicles over the next 20 years, and with most of them being eVTOL aircraft, the incumbents certainly have an interest in the UAM marketplace. While their relative inertia to innovate internal processes might give start-ups the edge in terms of rapidly prototyping and maturing technological innovations, those companies typically do not have the internal expertise to oversee regulatory compliance for either the air vehicles or their manufacture. That's where companies such as Airbus, Boeing, and Embraer play a major role, the sessions pointed out. This has also resulted in many making significant investments themselves in start-ups that are tackling some of the key technological issues. Battery technology remains one of the limiting factors to the performance along with financial viability of the UAM sector.

Gary Cutts, director of the UK government-backed Future Flight Challenge project, also noted that while start-ups drive the sector, they need to form consortia to present more rounded cases that encompassed the entire "ecosystem" surrounding UAM. That includes the involvement of regulators, operators, and local city governments, as well as an embrace of airspace, communications, and infrastructure requirements.

Hader though stated that start-ups need to step-up their testing and certification efforts and start preparing for industrialisation, all of which is high cash consuming but as development schedules are on track, and new milestone, such as test flights have been successfully reached, investors are now increasing their funding. Roland Berger is confident the UAM market will take-off after 2030, and then grow rapidly. "We are very positive about this industry and expect more than 160,000 passenger drones to be flying by 2050," Hader said. SP

PHOTOGRAPH: FIA

MITSUBISHI A6M ZERO – JAPAN'S JEWEL

Japan used the Zero fighter aircraft from the day it entered the War till the day it announced its unconditional surrender on August 15, 1945

ON DECEMBER 7, 1941, THE IMPERIAL JAPANESE NAVY launched 353 aircraft from six carriers in a surprise attack against the United States (US) naval base at Pearl Harbour triggering America's entry into the Second World War. Various types of aircraft participated in the raid including the Mitsubishi A6M "Zero".

If there was one aircraft that symbolised Japan's capability for air operations during the War, it was the A6M Zero. The first flight of this single engine fighter manufactured by the Mitsubishi Aircraft Company happened on April 01, 1939. It entered service with the Imperial Japanese Navy Air Service (IJNAS) on July 01, 1940 and tasted blood for the first time against the poorly equipped Chinese Nationalist Air Force. The Zero quickly gained the reputation of being the most capable carrier-based fighter in the world. Its range of over 2,600 kilometres enabled it to reach so many different targets that the Americans, whose reporting name for it was "Zeke", greatly overestimated its total numbers. It operated mainly from the aircraft carriers of the IJNAS, but many Zeros were also deployed on land. It is probably unique in the history of maritime aviation as a carrierborne fighter aircraft that proved superior in combat against most contemporary land-based fighters.

For several months after Pearl Harbour, the Zero reigned supreme in the Pacific theatre. Its combination of unmatched manoeuvrability and excellent firepower made it the scourge of the Allies. It won one air engagement after another. Even the British Supermarine Spitfire that had made short work of the German and Italian fighter aircraft, found the Zero a fearsome opponent. The Zero could comfortably out-turn the Spitfire and could remain airborne three times as long as the British fighter.

What accounted for the Zero's performance? It was a very light fighter built of a new lightweight aluminium alloy called extra super duralumin. Its weight saving measures bordered on the extreme. Unlike many aircraft of the time, it had no armour protection for the pilot, engine or other critical aircraft parts. Some pilots even dispensed with the parachute. Among the many single-engine fighters that operated during the War, the Zero was the unrivalled long-range champion. It also had a very low stalling speed of below 60 knots that made it a winner in manoeuvring during combat. However, the lack of selfsealing fuel tanks and armour plating, made it extremely prone to catching fire and exploding when struck by enemy bullets.

In the middle of 1942, the Americans managed to lay their hands on a practically intact A6M Zero that had crash landed. They quickly evaluated its weaknesses and formulated new counter tactics. Allied pilots were briefed to avoid a turning fight. Instead, with the help of ground radar cover, they would swoop down behind an unsuspecting Zero in a high-speed pass, fire a rapid burst of ammunition, then climb quickly back to where other Zeros could not follow. Meanwhile, the US Navy was fielding better, more powerful and more heavily armed fighters such as the Grumman F6F Hellcat and Vought F4U Corsair. In the Battle of Midway in June 1942, US forces gained a stunning victory over the Japanese.

The Japanese had been lulled into complacency by the initial invincibility of the Zero. They neither sought to reequip it with a more powerful engine nor to develop newer fighters capable of countering the US aircraft, till it was too late. There was also the problem of numbers. The Japanese fighter pilots initially received training that was second to none. But their numbers were no match for the tens of thousands of US pilots being churned out of its flying schools. As the losses of the elite Japanese pilots began to mount, those reaching the frontline were increasingly inexperienced and unable to get the best out of their Zeros. And Japan could not build fighters fast enough to match the phenomenal numbers being produced by the US.

On October 25, 1944, the Zero assumed its final tragic role – equipping volunteer pilots from various units on planned suicide missions against American surface vessels. The remarkable success of the first Kamikaze (Divine Wind) suicide squadron led to the formation of other similar units. According to the US Air Force, "Approximately 2,800 Kamikaze attackers sunk 34 Navy ships, damaged 368 others, killed 4,900 sailors and wounded over 4,800." Although different aircraft were used, the Zero was the favourite Kamikaze weapon.

In all, Japan built 10,939 Mitsubishi A6M Zeros, more than any other combat aircraft during the Second World War. The country used the aircraft from the day of its entry into the War (the Pearl Harbour attack) till the day it announced its unconditional surrender on August 15, 1945. SP

– JOSEPH NORONHA

A VERSATILE BIRD... *Continued from page 14*

KEY FEATURES OF THE C-390

The C-390 is the largest, heaviest and most complex military aircraft designed, developed and produced by Embraer to date. As per the OEM, the C-390 comes with the lowest life-cycle cost in the medium-lift category. This platform also signifies the level of technology in the domain of aerospace manufacturing that Embraer has achieved. The C-390 is a high-wing aircraft powered by two IAE V2500-E5 turbofan engines manufactured by International Aero Engines (IAE), a joint venture among leading manufacturers of aero engines such as Pratt & Whitney, MTU Aero Engines and Japanese Aero Engine Corporation. The IAE V2500 engine that delivers a thrust of 139.4 kN, also powers the Airbus and McDonnell Douglas MD90 airliners.

The C-390 aircraft has a tail loading ramp and raised empennage that provides unhindered access to the cargo hold. The aircraft now has a maximum payload capacity of 26 metric tonnes and can air drop 19 metric tonnes of load. It can seat 80 soldiers or 66 paratroopers with full operational gear. The fuselage is large enough to accommodate two armoured personnel carriers and can transport a helicopter as well. The aircraft has the capability to receive fuel while in flight and the Aerial Tanker version can refuel other aircraft in flight through two wing-mounted probe and drogue pods.

Operated by a crew consisting of two pilots and one flight engineer, the C-390 has a cruising speed of 870 km per hour or Mach 0.8 and a range of 2,820 km with a payload limited to 23 metric tonnes. It has a service ceiling of 36,000 ft and a ferry range of 6,130 km. The cockpit sports a dual Head Up Display configuration with dual-control systems for both pilots and has a digital Fly-by-Wire control system that makes handling at low speeds much easier so much so that it can even refuel helicopters in flight.

ROLE OF THE C-390

Apart from the Brazilian Air Force, there are a number of nations that have indicated their intent to procure this platform in varying numbers for their Air Forces or other agencies. Some of these are Argentina (6), Chile (6), Colombia (12), Czech Republic (2), Portugal (6) and Lisbon-based aviation services firm SkyTech (6).

With medium-lift capability, the C-390 will be employed by the Air Forces primarily in tactical roles such as transportation of troops and military equipment including heavy military vehicles especially where there is urgent need for rapid redeployment. The aircraft can airlift large quantities of cargo or personnel, at high speed, over long distances and with high dispatch reliability. It can also be deployed for maritime patrol as also to carry out in-flight refuelling of other aircraft including helicopters. The platform can be suitably modified to undertake several niche roles such as intelligence, surveillance and reconnaissance missions as well as to operate as a gunship or serve as an electronic warfare platform.

Apart from military tasks, the aircraft can be employed by the nation's Air Force for a variety of humanitarian missions such as medical evacuation, air drop of vitally needed supplies in case of widespread flooding or other natural disasters, search and rescue missions especially areas that are not easily accessible and to fight forest fires. The C-390 enhances the operational capability of the transport fleet. SP

TRENDS IN ELECTRONIC WARFARE... *Continued from page 16*

EW capabilities as it gears up for great power competition. Jon Harper wrote in National Defence in July 2019, that General Joseph Dunford, Chairman, Joint Chiefs of Staff said that EW is the Number One functional area where investments need to be made in the coming years. "Being in a position to achieve superiority in the electro-magnetic spectrum is absolutely critical," he said. The Congressional Research Service estimates that the department is seeking $10.2 billion for these capabilities in the year 2020. "If you take a look at what China and Russia are doing in terms of war-fighting strategy, they emphasize being able to operate effectively in the electro-magnetic spectrum," said Mark Gunzinger, Senior Fellow at the Center for Strategic and Budgetary Assessments. That includes being able to deny an enemy's ability to control the spectrum. It is a domain where wars can be won or lost, he said. The US military must take steps to ensure that it can "win the battle for the airwaves," he said. New offensive and defensive capabilities that could be useful include Directed Energy Weapons such as high power microwaves that are capable of destroying electronic components and new unmanned systems with EW weapons, he said. The stealthy F-35 joint strike fighter can also perform EW missions, he noted, "That is a very capable electronic-attack aircraft."

THE WAY AHEAD FOR INDIA

South Asia is becoming a place for EW action, including its coupling with Cyber Warfare (CW). President Xi Jinping has expanded the Central Military Commission's direct control over military operations and operational forces. Armed forces technical functions have been consolidated under the People's Liberation Army Strategic Support Force (PLASSF), clearly indicating greater focus on intelligence and information warfare. China recognises the complementarities between electronic warfare and cyber warfare. The theatre commands are tailored to exploit the unified information warfare service in the form of the PLASSF.

The Pakistan Air Force has acquired advanced Electronic Warfare capabilities and airborne warning and control system aircraft for Electronic Warfare and to support command and control. Another area that Pakistan has been pushing is the Software Defined Radio. These ensure clear or encrypted voice and data communication in VHF and UHF band and automatic integration with tactical and strategic networks to provide "cellular phone" services to tactical users. A China-made JY-27A counter-very-low-observable radar has been seen at Mianwali Airbase in Pakistan as per a Jane's report.

India's Land Warfare Doctrine 2018 clearly speaks of enhancing the capabilities in network-centric and EW. India now has a Defence Cyber Agency that is already active. The Indian Air Force's Integrated Air Command and Control System greatly enhances the network warfare capability. The Rafale will have a modern electronic warfare suite. Indian Naval ships have a powerful EW complement. India's network centric and EW capabilities include Battlefield Surveillance Radars, Weapon Locating Radar and Airborne Early Warning and Control Systems. Indigenisation of our EW systems is the next challenge. SP

QUICKROUNDUP

BOEING
The Boeing Company, Arizona, was awarded a $439,179,677 modification to contract W58RGZ-16-C-0023 for new Apache AH-64E aircraft and Longbow crew trainers. Work will be completed by March 01, 2025. FMS contract is for Morocco.

HENSOLDT
Sensor system supplier Hensoldt has been awarded a contract by Airbus Defence and Space to develop and produce a new Active Electronic Scanning Array (AESA) radar for the German and Spanish Eurofighter fleets.The project is jointly financed by the Eurofighter partner nations Spain and Germany, who will also be the first users of the radar in their fleets.

ISRAEL AIR FORCE
The Israel Air Forces' (IAF) Red Baron squadron's role is to train German crew to operate the Israeli "Eitan" (Heron TP) RPAV, as the German Air Force is in the process of developing their own version of the aircraft. "The 'Red Baron' squadron is the only non-Israeli Air force squadron that permanently operates in the IAF". They have completed 10 courses on Heron TP and the eleventh course is on.

KUWAIT
The Predator remotely piloted aircraft deployed at the Alî Al Salem air base in Kuwait, have reached the prestigious milestone of 10,000 flight hours in theatre. The aircraft are supplied to the ArabaFenice Task Group of the Italian National Contingent Command Air/Task Force Air-Kuwait. The Air Force Predators MQ-9 are engaged in Intelligence, Surveillance and Reconnaissance (ISR) missions.

L3 TECHNOLOGIES
L3 Technologies Inc, Texas has been awarded a $900,000,000 ceiling, indefinite-delivery/indefinite-quantity contract for simulator common architecture requirements and standards (SCARS) which provides for the definition, design, delivery, deployment and sustainment of a simulator common architecture across the Air Force's training portfolio, creation of a security operations centre and library as well as the execution of SCARS management services. SCARS has a 10-year ordering period through June 2030.

LOCKHEED MARTIN
Different versions of Lockheed Martin's F-35 have flown in hundreds of aerial exercises, deployed for overseas operations by the US Marines and US Air Force and attacked Taliban targets in Afghanistan. Despite all that, the $398 billion fighter programme hasn't been evaluated against the most stressing threats against sophisticated Russian, Chinese and Iranian air defence threats. The evaluation has slipped five more months due to COVID-19.

NETHERLANDS
The second Multinational MRTT aircraft was delivered to the Multinational MRTT Unit, at the Main Operating Base

MILITARY

ASIA-PACIFIC

DAC APPROVES ACQUISITION PROPOSALS WORTH ₹8,722.38 CRORE
To strengthen the Armed Forces by relying on indigenous capability to take forward the initiative on 'Atmanirbhar Bharat', the Defence Acquisition Council (DAC) in its meeting on August 11 this year Chaired by Raksha Mantri Rajnath Singh, accorded approval for capital acquisitions of various platforms and equipment worth approximately ₹8,722.38 crore that are required by the Indian Armed Forces. The key approval was for 106 basic trainer aircraft from Hindustan Aeronautics Limited (HAL) to address the basic training requirements of the Indian Air Force (IAF). HAL has successfully developed the basic trainer aircraft HTT-40 and certification process is underway. Post-certification, 70 aircraft will be initially procured from HAL and the balance of 36 after operationalisation of the first lot of 70 aircraft.

DAC APPROVES CAPITAL ACQUISITIONS WORTH ₹38,900 CRORE

Raksha Mantri Rajnath Singh chaired the DAC meeting in which approval was accorded for capital acquisition of various platforms and equipment worth ₹38,900 crore (about $5.2 billion). Focused on indigenous design and development these approvals include acquisitions from Indian industry of ₹31,130 crore.

These include Pinaka ammunitions, BMP armament upgrades and software defined radios for the Indian Army, Long Range Land Attack Cruise Missile Systems and Astra Missiles for the Indian Navy and Indian Air Force (IAF). Also included are 21 MiG-29 from Russia and procurement of 12 Russian Su-30 MKI aircraft to be built under license by HAL. Also upgrade of the existing fleet of MiG-29 aircraft with the IAF, is on the cards.

CHINA'S J-20 CAPABILITIES

The Chengdu J-20 marks the first entry of a multirole stealth fighter into China's armed forces. According to the US Department of Defence (DOD), China views stealth technology as a core component in the transformation of its air force from "a predominantly territorial air force to one capable of conducting both offensive and defensive operations." Designed for enhanced stealth and manoeuvrability, the J-20 has the potential to provide China with a variety of previously unavailable air combat options and enhance its capability to project power. As an advanced multirole stealth fighter, it is speculated that the J-20 can fulfil both air-to-air and air-to-ground combat roles for the People's Liberation Army Air Force and the aviation branch of the People's Liberation Army Navy.

AMERICAS

US AND RUSSIA REMAIN AT ODDS OVER EXTENSION OF START TREATY
The US and Russia have concluded a third round of arms-control talks and are still at odds over several key issues. However, the two sides showed willingness to possibly extend the New Strategic Arms Reduction (START) Treaty before it expires in 2021. New START, which caps the number of deployed long-range nuclear warheads each country can have, expires in February 2021, unless the two sides agree to extend it for five years. It is their last remaining bilateral nuclear-arms-control agreement. The US has urged China to join the negotiations — a proposal rejected by Beijing. Moscow believes that if China is to join, then Britain and France should also be engaged in an even wider process.

EUROPE

AIRBUS SIGNS CONTRACT FOR INTEGRATION OF 115 NEW EUROFIGHTER ESCAN RADARS
Airbus has been awarded a contract for the development, supply and integration of 115 Eurofighter E-SCAN Radars for

APPOINTMENTS

AIRBUS
Airbus has appointed Rémi Maillard as President of Airbus India and Managing Director of South Asia region, effective September 1, 2020.

CAE
Effective June 26, 2020, Heidi R. Wood has been appointed as the Interim Group President, Defence and Security of CAE.

EMBRAER
Following the appointment of Arjan Meijer as President & CEO of Embraer's Commercial Aviation business in June 2020, Embraer has also made the following appointments:

- Martyn Holmes as Chief Commercial Officer of Embraer's commercial unit based in Amsterdam.
- Cesar Pereira, has been appointed Vice President of Europe, Middle East and Africa (EMEA), Embraer Commercial Aviation, relocating from Singapore to the Amsterdam office.
- Raul Villaron as Vice President Asia Pacific, looking after Embraer's Commercial Aviation for the Asia Pacific region, excluding China.
- Mark Neely as Vice President of The Americas for Embraer Commercial Aviation.

GULFSTREAM
Gulfstream Aerospace Corporation has made the following appointments:

- Josh Thompson of General Dynamics Ordnance and Tactical Systems as the Chief Financial Officer, effective August 3, 2020.
- Wayne Oedewaldt as the Regional Senior Vice President of International Sales for Asia Pacific.
- Kirsten Krueger as the Regional Vice President of Sales for California's central coast.
- Roger Sperry, as Regional Senior Vice President of International Sales for Europe, the Middle East, Africa and the Indian subcontinent.
- Brent Monroe, Regional Senior Vice President for the Western US, is now also leading international sales for Latin America.

INDIAN AIR FORCE
Air Marshal V.R. Chaudhari AVSM VM, took over as Air Officer Commanding-in-Chief of Western Air Command, Indian Air Force (IAF) on August 1, 2020 from Air Marshal B. Suresh PVSM AVSM VM ADC who proceeded on retirement.

LOCKHEED MARTIN CORPORATION
Lockheed Martin Corporation has made the following appointments:

- With effect from June 15, 2020, James D. Taiclet, 60, took over as the President and CEO of Lockheed Martin Corporation.
- Frank A. St John, 53, as the Chief Operating Officer.
- Stephanie C. Hill, 55, succeeded St John as Executive Vice President of Lockheed Martin's Rotary and Mission Systems.
- Yvonne O. Hodge succeeded Hill as Senior Vice President, Enterprise Business Transformation.

TATA LOCKHEED MARTIN AEROSTRUCTURES LIMITED
On July 16, 2020, Tata Lockheed Martin Aerostructures Limited, a joint venture between Tata Advanced Systems Limited and Lockheed Martin Aeronautics appointed Kiran Dambala as the Chief Operating Officer.

the German and Spanish Eurofighter fleet. It marks the largest order so far for the world's most modern electronically scanned array radar. Captor-E radars are for Germany and an initial batch of five radars for Spain is required to be delivered by 2023. Captor-E is the world's most advanced electronically scanned array radar for fighter aircraft. The design of the front fuselage airframe allows Eurofighter to integrate the largest electronically scanned array for increased detection and tracking ranges, advanced Air-to-Surface capability and enhanced electronic protection measures.

QUICKROUNDUP

in Eindhoven in the Netherlands. Upon completion of the acceptance process, the ownership of the aircraft was transferred from Airbus Defence and Space to the NATO Support and Procurement Agency, that manages the fleet on behalf of the nations.

NORTHROP GRUMMAN SYSTEMS
Northrop Grumman Systems Corp, California, has been awarded a $222,507,873 cost-plus-fixed-fee contract for the Defence Support Programme Operations, Mission Threat Analysis and Engineering Sustainment) for on-orbit satellite and anomaly resolution support, root cause analysis, mission threat analysis etc. Work is expected to be completed by March 31, 2030.

RAYTHEON
Hungary has contracted for 60 Raytheon AIM-120C-7/C-8 AMRAAM Extended Range missiles, worth $250 million, "in support of Hungary's acquisition of the National Advanced Surface to Air Missile Air Defense System." Hungary is also buying the related AN/MPQ-64F1 Sentinel radars through a Direct Commercial Sale.

RAYTHEON MISSILES SYSTEMS
Raytheon Missiles Systems, Arizona, has been awarded a $495,058,000 cost-plus-fixed-fee, cost-plus-incentive-fee, firm-fixed-price, fixed-price-incentive-fee, indefinite-delivery/indefinite-quantity contract for advanced medium range air-to-air missile (AMRAAM) programme support and annual sustainment. Work will be completed by June 30, 2026.

SOUTH KOREA
South Korea has approved a plan to purchase more aircraft from overseas by 2027, rather than developing one at home, with a budget of $1.32 billion. Air Force operates four Boeing 737-based Peace Eye aircraft since 2011 and is pushing for two more. The committee also approved a project to secure advanced Baekdu reconnaissance aircraft between 2021-2026.

UNITED STATES (US)
Demonstrating airpower, bomber and fighter aircrew assigned and deployed to Pacific Air Forces, US launched four B-1 Lancers, two B-2 Spirit Stealth Bombers and four F-15C Eagles and conducted Bomber Task Force (BTF) missions simultaneously with joint and allied partners within the Indo-Pacific region over the course of 24 hours on August 17 this year. Pacific Air Forces routinely conduct BTF operations to show the US' commitment to allies and partners in the Indo-Pacific area of responsibility.

US PACIFIC AIR FORCES
Red Flag-Alaska 20-3, a US' Pacific Air Forces-sponsored exercise, concluded on August 14, 2020. Pilots completed roughly 560 sorties and logged approximately 1,500 flying hours which contributed to the pilots gaining the confidence needed to execute combat operations.

DO NOT JUST BLAME THE PILOT

In the recent case, holding the pilot responsible for the disaster would be highly inappropriate as it would divert the focus from more important issues related to aviation safety ecosystem

By **AIR MARSHAL B.K. PANDEY (RETD)**

THE MEDIA WAS RECENTLY ABUZZ WITH REPORTS ON THE crash of Air India Express Boeing 737 on August 7, 2020 while landing at the Calicut International Airport. The airliner was on a Vande Bharat Mission for the repatriation of Indian citizens stranded in the Middle East since the outbreak of the COVID-19 pandemic. The Air India Express flight took off from Dubai and was to land at Calicut International Airport at around 1940 hours. Unfortunately, for some reasons, things went horribly wrong as the aircraft overshot the runway while landing and fell into a gorge 35 feet deep. The fuselage of the aircraft broke up into two pieces, but fortunately did not catch fire. The pilot in command Deepak Vasant Sathe, the co-pilot Akhilesh Kumar, four members of the cabin crew and 14 passengers perished in the accident. Apart from these fatalities, over 100 passengers sustained serious injuries.

An accident involving an airliner that carries a large number of passengers on board, is a high profile event and is bound to attract national attention. And so has it been the case with the recent accident at Calicut International Airport. In an accident of this kind, the pilot in command becomes the primary focus of not only the investigating agency, but even for the public at large. This is primarily because it is the pilot in command who is on the controls, has to handle the aircraft both in normal operations as well as in emergency situation and is required to take all critical decisions. He may even ignore advice from the Air Traffic Control if he considers it inappropriate or not in the interest of flight safety which ought to be and generally is the primary focus of the pilot in command.

Every accident in the domain of the Indian civil aviation industry is investigated by the designated authorities to determine the factors that led to it, pinpoint responsibility for failures if any and recommend immediate remedial action as well long term measures to obviate the possibility of recurrence of such an event in the future. What is rather disturbing in this crash of Air India Express Boeing 737 is that even before the investigation had commenced, some senior functionaries related to Indian civil aviation made statements implying failure on the part of the pilot in command.

In this particular case, the pilot in command who had an immaculate professional track record, was confronted with adverse and extremely challenging situation. The prevailing weather with heavy rain, low clouds, poor visibility, strong and gusty winds posed a serious problem. The captain of the aircraft did make an instrument approach on runway 28 which was the Westerly runway that offered the advantage of strong head wind that would reduce the ground speed at the time of touchdown. Also, runway 28 provided a landing run that was up slope in which the far end of the runway was higher than the touchdown end by 30 feet. However, for some reason that hopefully will be ascertained by the investigating authority, the pilot had to abandon the approach for runway 28 despite the fact that it offered distinct advantages listed above. A reasonable guess would be that as the approach path for runway 28 lay over hilly terrain and with the existing low clouds, heavy rain and poor visibility, the pilot was possibly apprehensive of flying into the hills on the approach path. He therefore abandoned the approach for runway 28 as in all probability, he regarded it as unsafe and opted to land from the opposite direction on runway 10 where there were no hill features on the approach path. However, there were disadvantages in this option as the aircraft would experience strong tail wind thus increasing the touchdown speed that would result in longer landing run. To add to this, runway 10 had a down slope that would make it more difficult to stop the aircraft. Besides, the runway was waterlogged which degraded the efficiency of the braking system. The pilot in command was clearly battling against a host adversities.

Generally, there are multiple factors behind every major flying accident. In this particular case, the civil aviation authorities may assign the responsibility for the disaster at Calicut to lack of professional skill on the part of the pilot in command. They are also unlikely to highlight the failures on the part of the Air Traffic Control if any, in rendering appropriate advice to the pilot. But what is more disturbing is that the civil aviation authorities have failed to address the deficiencies and problems with regard to the table top runway at Calicut that had serious flight safety implications. These were pointed out by civil aviation specialist after the crash of Air India Express Boeing 737 while landing on the similar table top runway at Mangaluru airport a decade ago.

In the recent case, holding the pilot in command responsible for the disaster would be highly inappropriate as it would divert the focus from more important issues related to aviation safety ecosystem as also dent the morale of the flying community in India. SP

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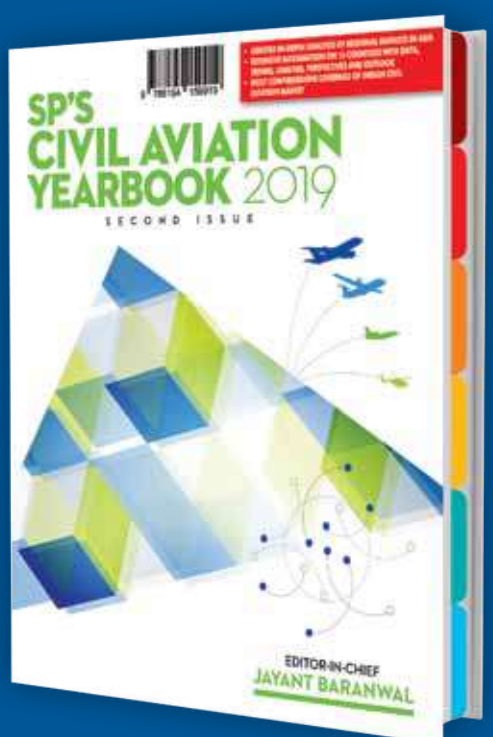

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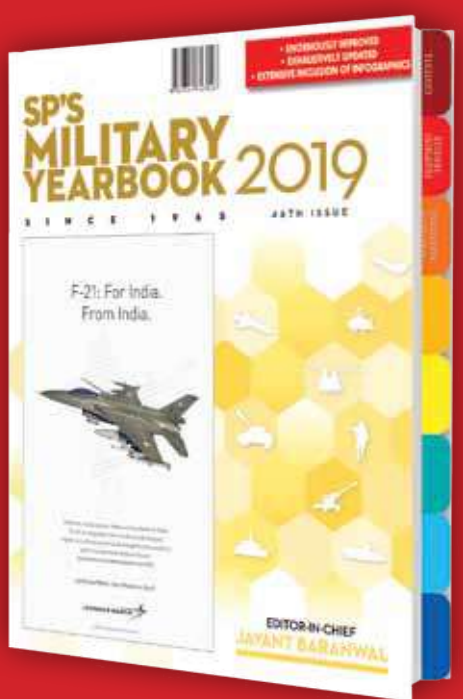

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