₹ 100.00 (INDIA-BASED BUYER ONLY)

SP's aviation

AN SP GUIDE PUBLICATION

ISSN 2230-9225

SHARP CONTENT FOR A SHARP AUDIENCE

www.sps-aviation.com

VOL 28 ISSUE 7 • 2025

EXCLUSIVE

"OUR GOAL IS TO COLLABORATE TOWARDS CONTRIBUTING TO (INDIA'S) SELF-RELIANCE DRIVE"

– **FRANCISCO GOMES NETO**, PRESIDENT & CEO, EMBRAER

PAGE 12

MILITARY

EXPERT-SPEAK: DEFENDING INDIAN SKIES

– AIR CHIEF MARSHAL **V.R. CHAUDHARI** (RETD)

PAGE 7

BUSINESS AVIATION

- **ANALYSIS: UNLOCKING GROWTH**
- **PEARL ENGINE FAMILY – POWERING THE LEADING BUSINESS JETS**

MUCH MORE...

NEW FRONTIERS

PAGE 19

GROUP CAPTAIN SHUBHANSHU SHUKLA OF THE INDIAN AIR FORCE RETURNED TO EARTH ON JULY 15, 2025, AFTER AN 18-DAY STAY ABOARD THE INTERNATIONAL SPACE STATION DURING THE AXIOM-4 MISSION, MARKING INDIA'S FIRST HUMAN SPACEFLIGHT IN 41 YEARS.

RNI NUMBER: DELENG/2008/24199

C-390 MILLENNIUM

UNBEATABLE COMBINATION FOR INDIA

UNRIVALLED MOBILITY. OUTSTANDING PERFORMANCE TRULY MULTI-MISSION.

Embraer and Mahindra Group are joining forces to offer the Indian Air Force the best global solution for its MTA (Medium Transport Aircraft) program – the C-390 Millennium. This new generation aircraft offers an unbeatable combination of unrivalled mobility, outstanding performance, operational flexibility and low lifecycle costs in a single platform. Three countries are currently operating the C-390 Millennium: Brazil, Portugal and Hungary, with the aircraft achieving a 93% mission capability rate. Embraer have a strong track record fostering partnerships in this part of the world – 45+ Embraer jets currently operate in India covering the Defense, Commercial and Executive Aviation sectors.

#C390UnbeatableCombination
c390mta.com

EMBRAER

CHALLENGE.
CREATE.
OUTPERFORM.

PUBLISHER AND EDITOR-IN-CHIEF
Jayant Baranwal

CONSULTING & CONTRIBUTING EDITOR
Manish Kumar Jha

CONTRIBUTORS
India:
Air Marshal Anil Chopra (Retd)
Group Captain Joseph Noronha (Retd)
Swaati Ketkar
Europe: Alan Peaford

CHAIRMAN & MANAGING DIRECTOR
Jayant Baranwal

EXECUTIVE VICE PRESIDENT
Rohit Goel

SR. EXECUTIVE - NEW INITIATIVES
Sarthak Baranwal

MANAGER - HR & ADMIN
Bharti Sharma

DEPUTY MANAGER - CIRCULATION
Rimpy Nischal

GROUP RESEARCH ASSOCIATE
Survi Massey

DESIGN
Holistic Directions: Jayant Baranwal
Sr. Designer: Vimlesh Kumar Yadav,
Designer: Sonu Singh Bisht

GROUP DIRECTOR - SALES & MARKETING
Neetu Dhulia

DIRECTOR - SALES
Rajeev Chugh

SP'S WEBSITES
Sr Web Developer: Shailendra Prakash Ashish
Web Developer: Ugrashen Vishwakarma

Subscription/Circulation
Annual Inland: ₹1,200 • Foreign: US$320
E-mail: subscribe@spguidepublications.com
subscribe@sps-aviation.com
LETTER TO EDITOR
editor@sps-aviation.com; expert@sps-aviation.com
For Advertising details, contact:
neetu@spguidepublications.com
rajeev.chugh@spguidepublications.com

SP GUIDE PUBLICATIONS PVT LTD
A-133 Arjun Nagar, (Opposite Defence Colony)
New Delhi 110003, India.
Tel: +91 (11) 40042498, 40793308
E-mail: info@spguidepublications.com

Representative Office
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

MEMBER / PARTNER OF
NBAA BACA

SP GUIDE PUBLICATIONS
WWW.SPGUIDEPUBLICATIONS.COM

TABLE OF **CONTENTS**

SP's aviation
SHARP CONTENT FOR SHARP AUDIENCE
VOL 28 ISSUE 7 • 2025

COVER IMAGE
As part of the Axiom-4 mission, India's Group Captain Shubhanshu Shukla spent 18 days on the International Space Station and returned to Earth on July 15, 2025. This mission marked India's return to human spaceflight after a gap of 41 years.
(***Cover Photo**: Astro_Ayers / X*)
COVER DESIGN BY: *SP's Team*

BACA Awards 2017
SPECIAL CONTRIBUTION TO BUSINESS AVIATION

Aerospace Media Awards — Asia
11th February 2020 – Singapore

A WORD FROM EDITOR-IN-CHIEF

Group Captain Shubhanshu Shukla's participation in the Axiom-4 mission marks a historic return for India to human spaceflight after over four decades. The success of this mission not only boosts India's global stature in space exploration but also lays a strong foundation for ISRO's upcoming Gaganyaan mission and long-term plans for an Indian space station.

THE 18-DAY SPACE ODYSSEY OF GROUP CAPTAIN SHUBHANSHU Shukla, aboard the Axiom-4 mission, is just a stepping stone towards India's significant plans for Space. Manish Kumar Jha captures the significance of India's collaboration with Axiom Space and SpaceX, providing essential know-how in astronaut training and in-orbit operations, paving the way for India's indigenous human spaceflight capability and eventual construction of an Indian space station by 2035.

The BRICS 2025 summit in Brazil marked a turning point as the bloc expanded its membership to 11 nations and reasserted its role as a counterweight to Western-dominated global institutions. The Rio Declaration emphasised inclusive global governance, multipolarity, and reform of agencies like the UN, IMF, and World Bank. Financially, BRICS is pushing for de-dollarisation and developing payment alternatives through platforms like BRICS PAY. A report by Manish Kumar Jha underscores BRICS' transformation.

Air Chief Marshal V.R. Chaudhari, Former Chief of the Air Staff details the development of India's radar and command systems from the 1950s to the IACCS network of today, which seamlessly links surveillance, decision-making, and weapon systems. The article ends with a call to enhance aerospace domain awareness and rapidly induct new-age radar and anti-stealth capabilities to stay ahead in future conflicts.

In an exclusive interview to us, Francisco Gomes Neto, President and CEO of Embraer elaborates on the company's strategic plans in India, including opening a new office in New Delhi. He reaffirms the company's commitment to deepen collaboration across defence, commercial aviation, and MRO through localisation and partnerships. Neto discusses their legacy in India with 11 aircraft types currently operating in the country and the potential of the C-390 Millennium in the MTA programme. The CEO expresses willingness to set up a final assembly line if significant orders materialise, reinforcing Embraer's role as a long-term partner in India's aerospace ecosystem.

In his article, Rohit Goel offers a comprehensive overview of Rolls-Royce's Pearl engine family—Pearl 15, Pearl 700, and Pearl 10X—currently powering top-tier business jets like the Bombardier Global 6500, Gulfstream G700, and Dassault Falcon 10X. The article explores each engine's design breakthroughs, such as advanced compressors, blisked fans, and digital health monitoring, that enhance fuel efficiency, thrust, and environmental performance. The story reinforces Rolls-Royce's role in shaping sustainable, high-performance propulsion for business aviation.

On the business aviation front, in an analytical feature on India's Business Aviation outlook, Sanjay Julka dissects the emerging trends, emphasising the role of GIFT City and the rise of structured financing options such as operating leases and export credits. The article explains how regulatory reforms are catalysing interest among Indian corporates in aircraft leasing through domestic entities. We also have a report on the recently held Paris Air Show 2025. The 2025 edition showcased cutting-edge aerospace innovation, sustainability initiatives, and major defence deals. With electric aviation, hydrogen propulsion, and AI-driven systems in focus, the event highlighted Europe's commitment to decarbonisation. Key industry players unveiled next-gen technologies, reinforcing global momentum towards cleaner, smarter, and more secure air mobility solutions.

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

JAYANT BARANWAL
PUBLISHER & EDITOR-IN-CHIEF

FOLLOW US ON
@SPsAviation | facebook SPPublications

AT BRICS SUMMIT 2025 IN BRAZIL, THE EXPANDED ALLIANCE SIGNALLED AN EMERGING ALTERNATIVE TO THE WESTERN-DOMINATED WORLD ORDER AND ARTICULATED A FAIRER REPRESENTATION FOR THE DEVELOPING WORLD

SHAPING OF BRICS: AN EMERGING ALTERNATIVE GLOBAL REALITY

Despite the challenges and lack of consensus on some issues, the BRICS 2025 Summit in Brazil, with the Rio de Janeiro Declaration, concluded with greater strength and resolve—it is here to stay

By MANISH KUMAR JHA

PHOTOGRAPH: NARENDRAMODI / X

THE BRICS GROUPING—ORIGINALLY COMPRISING BRAZIL, Russia, India, China, and South Africa—has evolved from a loose economic bloc into a geopolitical force with far-reaching ambitions. With its expansion to 11 members, including countries like Egypt, Ethiopia, Iran, Indonesia, Saudi Arabia, and the UAE, BRICS is no longer a niche coalition of emerging markets but a formidable consortium representing over 40 per cent of the global population and a rising share of global GDP.

At its core, this expanded alliance signals an emerging alternative to the Western-dominated world order and articulates a long-overdue demand: fairer representation for the developing world. The BRICS summit in Rio de Janeiro signifies the bloc's continued efforts to strengthen cooperation among emerging economies.

PRIME MINISTER NARENDRA MODI ADDRESSING THE SESSION ON 'PEACE AND SECURITY AND REFORM OF GLOBAL GOVERNANCE' ON THE SIDELINES OF 17TH BRICS SUMMIT AT RIO DE JANEIRO, IN BRAZIL

At the same time, BRICS countries have diverse geopolitical interests and have faced regional conflicts and disputes, which hinder cooperation.

RAISING DEMOCRATIC AND INCLUSIVE GLOBAL GOVERNANCE

There is no denying that institutions that govern the global economy, particularly the United Nations Security Council (UNSC), the International Monetary Fund (IMF), and the World Bank still playing the dominant role; their failure on multiple fronts and Western institutional approach are equally visible.

The developing world, despite being home to the majority of humanity, remains under represented. Africa, for instance, has no permanent seat at the UNSC, and voting power at the Bretton Woods institutions is still heavily skewed in favour of the United States and its allies.

BRICS has consistently called for reforms to these institutions. The demand is not for dismantlement but for democratisation. A more representative Security Council would better reflect contemporary geopolitical realities, where power and influence are far more distributed. Similarly, rebalancing voting rights within the IMF and the World Bank would make these institutions more responsive to the development needs and policy preferences of the Global South.

Moreover, as India takes over the leadership from Brazil next year, it hints at building a 'new form'. Prime Minister Narendra Modi announced such intention at the grouping's summit in Rio De Janeiro on July 7. India is also infusing technology into the BRICS deliberation, driving initiatives in AI, digital infrastructure, and cybersecurity within BRICS. Tech and security in the BRICS mandate will certainly be more meaningful than a lot of plenary talks that become just a routine.

"Under India's BRICS presidency, we will work to define BRICS in a new form. BRICS will mean Building Resilience and Innovation for Cooperation and Sustainability. Just as during our G-20 chairmanship…" he said.

"The BRICS Summit was a splendid opportunity to elaborate on issues impacting the planet and the importance of the Global South in the global high table. I also spoke about different aspects relating to health, technology and climate change."
— Narendra Modi, Prime Minister of India

PHOTOGRAPH: PIB

MULTILATERALISM, NOT HEGEMONY

Contrary to portrayals of BRICS as a rival bloc to the West, the group has positioned itself as a defender of multilateralism. BRICS countries reaffirmed their commitment to multilateralism and defending international law, including the UN Charter.

It seeks a multipolar world—one where decision-making is not monopolised by a few but shared by many. BRICS' repeated calls for adherence to international law, the centrality of the United Nations, and commitment to peaceful dispute resolution are rooted in this multilateral vision.

Its endorsement of the Paris Agreement on climate change is another example of its consensus-based directive. As both victims of and contributors to climate change, BRICS nations have an interest in climate justice. BRICS pushes not only for action but for fairness—insisting that developed countries honour their commitments to climate finance and technology transfer.

TOWARDS A NEW FINANCIAL ARCHITECTURE

The BRICS bloc is not only proposing institutional reform but actively building alternatives. The New Development Bank (NDB), established in 2015, offers an alternative to the World Bank, financing infrastructure and sustainable development projects without the stringent policy prescriptions of Western lenders. The Contingent Reserve Arrangement is a buffer against financial instability, providing liquidity support in times of crisis. The BRICS Cross-Border Payments Initiative (BCBPI), while still progressing, is certainly demonstrating efforts towards financial cooperation and alternative financial systems.

The push for de-dollarisation—creating alternatives to the US dollar in international trade—is gaining traction within BRICS. This is not an ideological crusade but a practical response to the weaponisation of the dollar through sanctions and monetary policy that disproportionately affects non-Western economies. With discussions around a BRICS common currency still a work in progress, the group has encouraged the use of national currencies in trade settlements, is exploring ways to build a more resilient and less dollar-dependent global financial system. BRICS also highlighted advancing digital payment platforms like BRICS Bridge and BRICS PAY among the group.

However, challenges remain in building consensus on some initiatives, such as the proposed BRICS Credit Rating Agency (CrRA), which has not advanced due to a lack of consensus.

A PRACTICAL AGENDA

There are opinions that BRICS still lacks a coherent agenda to implement amid the factions being played out in geopolitics.

PRIME MINISTER MODI RECEIVING BRAZIL'S HIGHEST HONOUR - 'THE GRAND COLLAR OF THE NATIONAL ORDER OF THE SOUTHERN CROSS' BY THE PRESIDENT OF BRAZIL

PHOTOGRAPH: PIB

> BRICS is no longer a niche coalition of emerging markets but a formidable consortium representing over 40 per cent of the global population and a rising share of global GDP

With its enlarged membership, BRICS is not symbolic—it is building some operational mechanism. Its agenda includes cooperation on energy, digital infrastructure, education, public health, and conflict resolution. The inclusion of major oil exporters and key regional powers adds strategic weight to its actions and raises the potential for genuine South-South cooperation.

Yet challenges remain. Internal divisions, geopolitical rivalries, and differing economic models can hinder consensus. But the group's strength lies in its diversity—and in its shared vision of a more equitable global order.

The rise of BRICS is not a rejection of the global order but a reimagining of it. Its expanded membership and growing influence underscore a world in transition, where emerging powers are no longer willing to be passive rule-takers.

Despite all such insecurities, BRICS has positioned an alternative architecture—rooted in multipolarity, fairness, and sovereignty—that will rise to fill the void. And the world should take note. SP

Manish Kumar Jha is a Consulting & Contributing Editor for SP's Aviation, SP's Land Forces and SP's Naval Forces and a security expert. He writes on national security, military technology, strategic affairs & policies.

S-400 IS AMONGST THE MOST ADVANCED AIR-DEFENCE SYSTEM IN THE WORLD AND USED VERY EFFECTIVELY DURING OPERATION SINDOOR

PHOTOGRAPH: ENG.MIL.RU

DEFENDING INDIAN SKIES

During Operation Sindoor, Pakistan launched multiple attacks on India's military installations and airfields, using missiles, rockets and drones. However, Pakistan's every single projectile was intercepted by Indian Armed Forces and brought down before it could reach the intended target.

By **AIR CHIEF MARSHAL V.R. CHAUDHARI (RETD),**
FORMER CHIEF OF THE AIR STAFF, INDIAN AIR FORCE

THERE HAS BEEN CONSIDERABLE DISCUSSION ABOUT THE successful execution of Operation Sindoor. The Indian Air Force (IAF) not only conducted offensive operations efficiently, but also ensured that its robust Air Defence (AD) system prevented any Pakistani missiles, drones, or rockets from reaching their intended targets. What constitutes this integrated AD system? What are the technologies that support this capability? This article will provide the reader with a comprehensive historical perspective, enlightening them on how the IAF meticulously developed such a system.

EVOLUTION OF INDIA'S AIR DEFENCE CAPABILITIES

The Russia-Ukraine conflict has showcased some spectacular surface-to-air missile engagements, specifically those fired from the Man-Portable Air Defence Systems (MANPADS) used by both sides. Many of these MANPADS first appeared in Afghanistan in 1979 and have since been acquired by various terrorist organisations. Helicopters have become particularly vulnerable in areas heavily populated with shoulder-fired missiles of all hues. As a result, the Russian military has faced significant losses, including many helicopters and some fighter aircraft. In

WEAPON SYSTEMS HAVE BEEN DIGITISED, AND THE ARCHITECTURE OF IACCS NOW PERMITS NEWER EQUIPMENT TO PLUG AND PLAY. (LEFT) SUCCESSFUL FLIGHT-TEST OF NEW GENERATION AKASH MISSILE; (RIGHT) MEDIUM RANGE SURFACE TO AIR MISSILE.

response to these losses, they began flying at higher altitudes to avoid the maximum effective ranges of these missiles. However, this tactic also made them susceptible to long-range radar-guided missiles, which continued to impact their operational capabilities. In response, a focused, albeit limited, campaign was launched to suppress the Air Defence systems as a precursor to deep interdiction and strategic strikes.

The Middle East has witnessed a stark contrast between threats and actions. At times, short-range rockets launched by Hamas have been accompanied by long-range ballistic missiles from Iran, putting pressure on Israel's air defences. The famed Iron Dome system, which integrates radar technology with surface-to-air missile systems (SAM), demonstrated its effectiveness by intercepting and destroying most of the incoming projectiles.

Russia and China thoroughly analysed the conduct and outcomes of the first Gulf War, leading them to reorganise their forces and develop what is now known as Anti-Access Area Denial (A2AD) capabilities. In 2006, China issued a white paper on its national defence, with an emphasis on "information warfare". This approach interlinked command and control systems with weaponry and also extended these networks to include space-based assets, cyber elements, and decision-making entities. Over the years, these capabilities have been strengthened through the induction and integration of newer ground-based and airborne weapons and sensors.

In India, the first radar units were set up in the late 1950s, equipped with Marconi radars purchased from the United Kingdom (UK). After the 1962 debacle, India realised that deploying long-range radars would enhance air defence and air control. The United States of America (USA) agreed to sell six Star-Sapphire radars to us, and new units were raised across the northern and western borders. Unfortunately, while we did receive the equipment, the Americans did not fulfil the requirement of operationalising it due to their leanings after the 1965 war with Pakistan. The IAF had to rely on the technical prowess of its engineers to set up a new unit, the Electronic Engineering and Installation Unit, to not only get the radars operational but also to maintain them with minimal support. By the late 1960s, these radars were providing most of the air space surveillance along the western front. During the 1971 conflict, radar operators and fighter controllers carried out numerous successful interceptions of enemy fighters while also ensuring the safe recovery of their fighter aircraft. Just before the war, the IAF had also received the first lot of Soviet P-30 radars. This would have been the turning point in our AD capabilities, with two technologically diverse pieces of equipment performing the onerous role of defending Indian skies.

> Our integrated Air Defence system, featuring shooters ranging from the S-400 to vintage L-70 guns, can counter almost all incoming projectiles, demonstrating the system's robustness

PHOTOGRAPHS: PIB

FROM PLAN-ADGES TO IACCS: BUILDING A CONNECTED SHIELD

However, communication between the radar units remained a weak area, aside from the significant gaps in radar coverage. In the true spirit of Atmanirbharta, the IAF conceived what was to be known as 'Plan ADGES' (Air Defence Ground Environment System), intending to interconnect all static and mobile radar stations with a reliable microwave communication system and to fill the gaps in radar coverage along the borders. This plan was to be based on indigenous capabilities and was steered by the Prime Minister's Office through the Radar and Communications Project Organisation (RCPO). By the end of 1970, troposcatter communication units had formed a rudimentary network between the radar stations.

With the induction of the French Thomson-CSF THD-1955 radar in the mid-1970s, radar coverage increased substantially, and Bharat Electronics Limited (BEL) had licensed-produced these along with the PSM-33 radars. The programme gained steam, and over the next three decades, ADGES served the IAF and the nation well. Based on the reliable communication system, the air defence operations underwent many systematic changes. The low-level radars provided Ground Control Intercept (GCI) capabilities, and GCI units were brought under the control of Air Defence Direction Centers. (ADDCs). The western and northern fronts were covered by numerous ADDCs, which featured a combination of high-power radars, low-level radars, and even Mobile Observation Posts (MOPs), providing surveillance, as well as intercept and recovery directions for fighter aircraft.

Another turning point in AD capabilities came after a Latvian-registered An-26 aircraft dropped a large cache of arms in the Purulia district of West Bengal in December 1995. It was later intercepted and forced to land in Mumbai. The lack of pan-India radar coverage was the primary reason the aircraft remained undetected in Indian airspace. The government formed a committee that determined that a large number of radars would be required to fill in the gaps, particularly in peninsular India. This resulted in the procurement of a large number of static and mobile radars, most of which were designed and developed by the Electronics & Radar Development Establishment (LRDE) and manufactured by BEL.

Integrating radars of multiple origins and varying technologies was a big challenge. The Automatic Data Handling System, developed by BEL, could overcome the problem to some extent. However, the growing civil air traffic, along with the introduction of new-generation fighter aircraft, necessitated the establishment of data sharing and secure communications between Radar units and ADDCs. In the early years of this century, the IAF conceived a terrestrial network, the AFNET (Air Force Network), that would link all units through a secure medium. The next step was to develop a fully automated data handling system that would provide a recognised air picture of the entire Indian airspace.

During peacetime and conflict situations, the IAF carries out 24/7 air defence duties, including surveillance, facilitating civilian air traffic through Air Defence Identification Zones (ADIZ), and maintaining air defence alerts with fighter aircraft and SAMs. To put it into perspective, over 10,000 flights originate from or transit over the country every day. Each one is to be assigned an Air Defence Clearance number and must be identified. Given the considerable responsibility of safeguarding the vast airspace, the IAF recognised the need for automation and networking aided by robust decision-support systems.

> The Integrated Air Command and Control System (IACCS) was developed, which now interconnects all surveillance systems — both airborne and ground-based — with the shooters, specifically the fighter aircraft and SAMs

The Integrated Air Command and Control System (IACCS) was developed, which now interconnects all surveillance systems — both airborne and ground-based — with the shooters, specifically the fighter aircraft and SAMs. The surveillance elements provide a fused, common air picture that has allowed the IAF to retain centralised command over all elements. However, due to the vast geographical span of the country and regional commands having independent control over allotted resources, the system allows for distributed control over air defence activities. Finally, the shooters are

MILITARY | EXPERT-SPEAK

THE FUTURE LIES IN ENSURING THAT NETWORK-CENTRIC WARFARE/OPERATIONS REMAIN THE CORNERSTONE OF THE ONGOING TRANSFORMATION. (LEFT) AKASHTEER SYSTEM; (RIGHT) AIR LAUNCHED BRAHOMS MISSILE.

PHOTOGRAPHS: BEL_CORPCOM / X, INDIAN AIR FORCE

DURING OPERATION SINDOOR, THE INTEGRATED AIR COMMAND AND CONTROL SYSTEM (IACCS) PLAYED A SIGNIFICANT ROLE SUCCESSFULLY MANAGING AIR OPERATIONS AS A VITAL PART OF INDIAN AIR DEFENCE, THE IACCS HAS A NETWORK THAT ALLOWS IT TO DETECT, TRACK, AND IDENTIFY AERIAL TARGETS AS HOSTILE WHEN THEY APPEAR.

granted full authority to execute the mission. This decentralised execution provides flexibility and a shorter decision-making chain. This feature of centralised command and decentralised execution sets the IAF apart from the other services, which need resources to be placed under command for effective utilisation.

OPERATION SINDOOR: A REAL-TIME TEST OF INTEGRATION AND PRECISION

During Operation Sindoor, Pakistan launched multiple attacks on India's military installations and airfields, using the Fatah-2 rockets and an assortment of drones. Pakistan's every single projectile was intercepted and brought down before it could reach the intended target. The IACCS proved its worth by rapidly detecting, identifying, and allocating targets to the appropriate weapon system for destruction.

The biggest challenge to any air defence system is the ability to engage targets with widely varying parameters. The terminal speed of a ballistic missile can be thousands of kilometres per hour, while small drones may fly at speeds as low as 25 kmph to 30 kmph. Our integrated Air Defence system, featuring shooters ranging from the S-400 to vintage L-70 guns, can counter almost all incoming projectiles, demonstrating the system's robustness.

THE FUTURE OF AIR DEFENCE: NETWORK-CENTRIC WARFARE AND EMERGING TECHNOLOGIES

Keeping pace with technology, the IAF has periodically upgraded the hardware and software of the AFNET and IACCS. Weapon systems have been digitised, and the architecture of IACCS now permits newer equipment to plug and play. Counter-drone systems operated by multiple agencies can now be efficiently utilised, and with Artificial Intelligence (AI)-based decision support systems, the capabilities of our Air Defence system can ensure the sovereignty of Indian air space. The need of the hour is the rapid induction of VHF (Very High Frequency) radars to detect stealth and low-observable platforms, as well as passive radar systems and highly mobile, high-power radars. To maintain a decisive advantage over our adversaries, we will need 4.5 to 5th-generation aircraft equipped with beyond-visual-range weapons and long-range SAMs in sufficient quantities.

Aerospace domain awareness is another area that requires strengthening. This requires seamlessly linking airborne and ground-based sensors with space-based assets to provide information on all cooperative and non-cooperative targets, extending up to near space. Ballistic missile defences and the protection of high-value assets depend on a high level of aerospace domain awareness.

The personnel of the IAF deserve credit for recognising the necessity of integrating all ground-based radars through the Plan-ADGES over half a century ago. This initiative eventually evolved into the IACCS, which played a crucial role in the success of Operation Sindoor.

The concept of network centric operations was adequately proven and networking of sensors, commanders, and shooters resulted in showing how a flatter hierarchy can reduce operational pauses, enhance precision and increase speed of command. Tactical interoperability with the Army's Akashteer system ensured that human soldiers manning AD gun systems along with their command & control systems, could be seamlessly connected in a single communication fabric, with a common battle management system. The future lies in ensuring that Network-centric warfare/operations remain the cornerstone of the ongoing transformation efforts. SP

PHOTOGRAPH: PIB

C-390 MILLENNIUM AND BEYOND: EMBRAER'S COMMITMENT TO INDIA'S DEFENCE VISION

Embraer Defense & Security supports India's long-term vision for defence modernisation, innovation and strategic alliances

(LEFT) C-390 MILLENNIUM; (RIGHT) EMBRAER TEAM AT AERO INDIA 2025.

AS GLOBAL PARTNERSHIPS EVOLVE AND DYNAMICS SHIFT, the longstanding ties between India and Brazil are strengthening – most recently through state visits and high-level dialogues and collaborations, including the recent BRICS Summit. Building on this legacy, Embraer sees opportunities to grow its commitment to India and contribute to meeting India's evolving aerospace and defence needs, with a potential to assist India's efforts towards achieving 'Atmanirbhar Bharat' (self-reliance).

Currently, there are close to 50 Embraer aircraft across 11 aircraft types operating in the country, from defence to commercial aviation and business aviation, all supported by Embraer's service & support network in the country.

Embraer's latest aircraft, the C-390 Millennium multi-mission, medium-lift, military transport aircraft has been swiftly growing its global operator base and promises to be a versatile and effective asset to India's defence needs – contributing to its modernisation goals and fulfilling operational requirements.

The C-390 Millennium flies faster (470 knots) and farther and can carry more payload (26 tonnes) compared to other medium-sized military transport aircraft.

THE PLATFORM OF PROVEN PERFORMANCE

The C-390 Millennium has redefined expectations in the medium transport segment. Countries such as Portugal, Hungary, the Netherlands, Austria, South Korea, Czech Republic, Sweden, Slovakia, and most recently Lithuania have selected the C-390 to modernise their air forces. With a payload capacity of 26 tonnes, high cruise speed, extended range, and the ability to operate on unpaved or temporary runways, the aircraft delivers unmatched flexibility.

Its modular architecture enables swift reconfiguration for a variety of missions – including cargo and troop transport, medical evacuation, firefighting, search and rescue, and humanitarian assistance. The KC-390 variant, with air-to-air refuelling capabilities for both fixed-wing and rotary aircraft, adds further operational value.

In service with the Brazilian Air Force since 2019 – and more recently with Portugal and Hungary – the C-390 has achieved a a mission capability rate of 93 per cent and mission completion rates above 99 per cent, underscoring its reliability, availability, and mission readiness.

INDIA: STRATEGIC FIT AND FORWARD THINKING

India's diverse topography and security demands make operational flexibility a top priority. From the Himalayas to the Thar Desert, Indian forces require aircraft that can perform in hot, high, dry, or humid conditions. Embraer believes the C-390's robust design and multi-mission capabilities are a natural fit for these challenges.

The C-390 Millennium was on display at Aero India 2025 and the strong interest it received underscored India's growing appetite for versatile multi-mission platforms that can enhance and transform the country's defence capabilities.

Beyond the aircraft and its capabilities, Embraer is committed to supporting India's 'Atmanirbhar Bharat' vision. A Memorandum of Understanding (MoU) signed with Mahindra Defence Systems to evaluate the opportunity to jointly pursue the Indian Air Force's Medium Transport Aircraft (MTA) programme with the C-390 Millennium represents a strategic step.

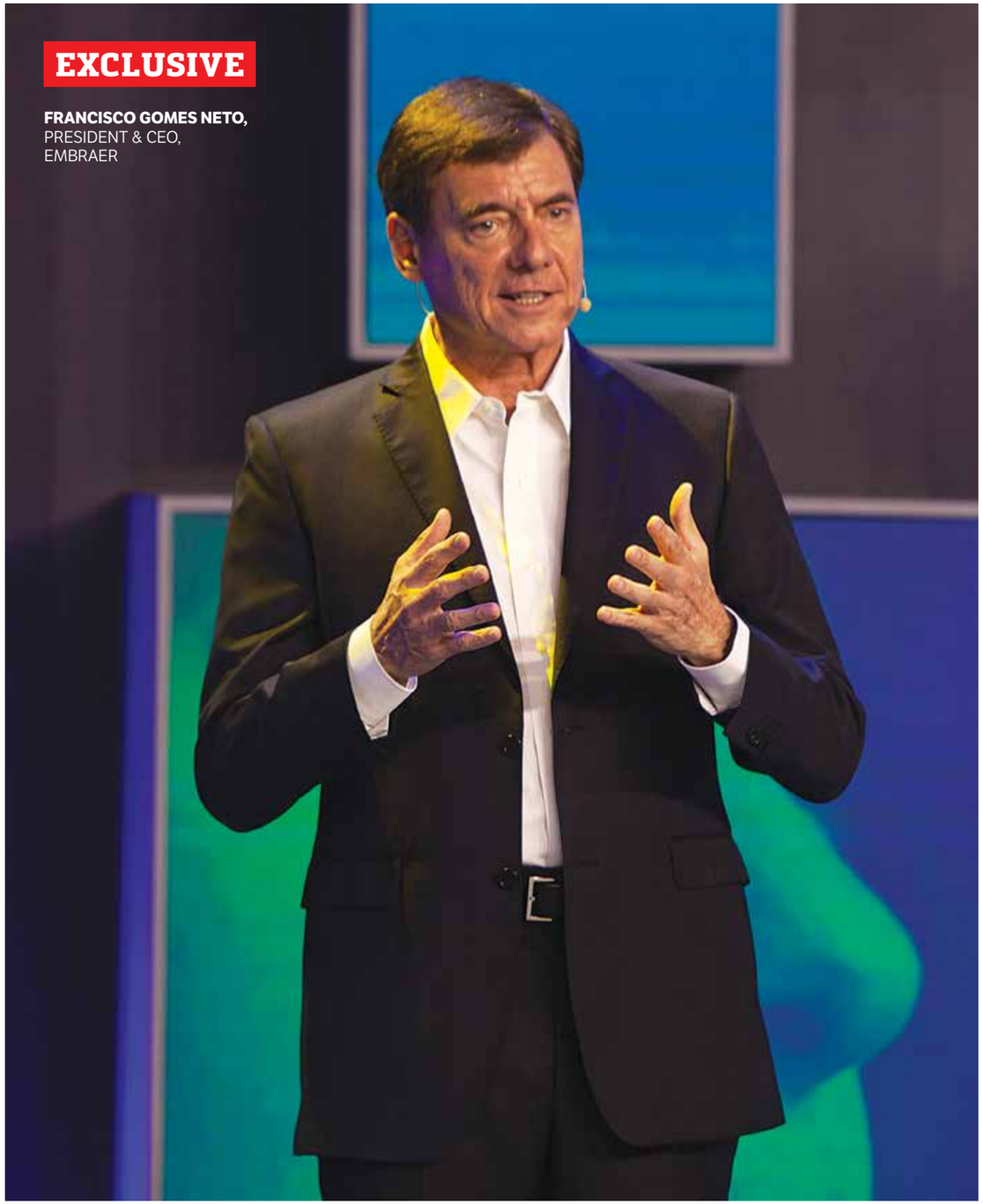
A STRONG TRACK RECORD OF EXCELLENCE

Embraer will mark its 56th anniversary in August and its journey has been marked by resilience, innovation and a commitment to engineering excellence. In the last two decades, Embraer has designed, developed and entered into service more than 20 different aircraft types across defence, commercial aviation and business aviation. The company seeks to collaborate with like-minded partners, eager to take aerospace and defence capabilities to greater heights.

Embraer DNA of engineering excellence is reflected in the performance and reliability of its aircraft in the country. Moreover, the successful DRDO-Embraer collaboration on the Netra AEW&C aircraft based on the ERJ145 platform stands as proof of Embraer's ability to partner with Indian institutions.

With a commitment to India and a desire to contribute to the country's aerospace and defence ambitions, Embraer is poised to become a long-term partner in India's defence journey. SP

PHOTOGRAPHS: EMBRAER



PHOTOGRAPH: EMBRAER

INTERVIEW | EMBRAER PRESIDENT & CEO

"THE GOAL IS TO COLLABORATE MORE TOWARDS BECOMING A LONG-TERM TRUSTED PARTNER, FULFILLING INDIA'S AEROSPACE AMBITIONS"

Francisco Gomes Neto, President & CEO, oversees all businesses - defence, commercial aviation, business aviation, services & support, urban air mobility and engineering of Embraer. He talks to **Jayant Baranwal, Editor-in-Chief**, at the occasion of opening an office in New Delhi and the company's investment in India's developing aerospace ecosystem

Jayant Baranwal (Baranwal): What are the key objectives behind Embraer establishing an office in New Delhi, India?

Francisco Gomes Neto (Neto): Setting up a fully owned subsidiary and corporate office in New Delhi marks a decisive step in Embraer's long-term strategy for India and I see lots of potential for collaboration with India's rapidly evolving aerospace and defence landscape.

Our objective is to build a strong local foundation to drive growth across defence, commercial and business aviation, services & support, and urban air mobility.

By establishing on-ground teams in procurement, supply chain, engineering, and corporate functions, we are investing in deeper integration with India's aerospace & defence ecosystem, supporting the 'Make in India' vision through local capability building and partnerships.

Baranwal: What are the reasons that reflect Embraer's committed approach towards the Indian market and its potential requirements?

> "Our objective is to build a strong local foundation to drive growth across defence, commercial and business aviation, services & support, and urban air mobility"

Neto: Embraer has been in India for years. We have nearly 50 Embraer aircraft and 11 aircraft types currently operating in the country from commercial aviation to defence and business aviation, all supported by Embraer's service & support network in the country. This includes the Legacy 600 operated by Indian Forces and 'Netra' AEW&C aircraft based on the Embraer ERJ145 platform operated by the IAF. We also have E-Jets and ERJs operated by the regional airline Star Air.

We believe the moment is right to take things up a notch. We have the MTA programme firmly in focus and we believe the C-390 is the ideal aircraft for India's defence needs. We are actively collaborating with Indian industry, including a landmark MoU signed in February 2024 between Embraer Defense & Security and Mahindra Defence Systems to evaluate the opportunity to jointly pursue the Indian Air Force's Medium Transport Aircraft (MTA) programme with the C-390 Millennium.

On the commercial aviation side, we foresee a potential for 300 aircraft over

EMBRAER IS LOOKING TO BE A LONG-TERM PARTNER TO INDIA ACROSS SECTORS:
(CLOCKWISE FROM TOP LEFT) PROPOSED C-390 MILLENNIUM FOR IAF'S MTA PROGRAMME; MOU SIGNING WITH MAHINDRA FOR THE MTA PROGRAMME; IAF'S NETRA AEW&C AIRCRAFT BASED ON ERJ145 PLATFORM; LEGACY 600 AIRCRAFT USED BY IAF FOR VIP TRANSPORTATION

the next 10 years in the segment of up to 150 seats in India. We believe that the E-Jets family will bring significant benefits to India's air connectivity by unlocking opportunities found in tier two and tier three cities and contributing to India's aspirations of becoming a leading global aviation hub. As proven with Star Air – an all-Embraer operator, the E-Jets have transformed and enhanced regional connectivity.

From deepening partnerships to investing in talent and supply chains, every move underscores our commitment to meeting India's evolving aerospace and defence needs, with a potential to assist India's efforts towards achieving 'Atmanirbharta' (self-reliance).

If we secure a large order from India, be it defence or commercial aviation, we are even open to setting up a final assembly line.

Baranwal: What kind of partnership does Embraer wish to build upon with India in the coming times, beyond offering solutions to the defence ecosystem?

Neto: Embraer is looking to be a long-term, value-added partner to India across sectors.

In defence, we see our multi-mission, medium-lift, military transport aircraft, the C-390 Millennium as a versatile and effective solution for IAF's MTA programme. As a platform equipped with the latest technological advancements it will certainly enable the acceleration of India's defence modernisation and fulfill operational requirements.

The aircraft was in India at the recent Aero India in February 2025 and especially in the last 12 months, we have received orders from more countries around the world. Lithuania joined Portugal, Hungary, the Netherlands, Austria, Czech Republic, Sweden, Slovakia and South Korea in choosing the C-390 to modernise their air forces, in addition to the Brazilian Air Force.

> "If we secure a large order from India, be it defence or commercial aviation, we are even open to setting up a final assembly line"

Beyond defence, we see immense potential in commercial aviation, business aviation, urban air mobility, and MRO ecosystem development.

We aim to deepen industrial cooperation, be it through co-development, local sourcing, or joint capability building. The goal is to collaborate more towards becoming a long-term trusted partner, fulfilling India's aerospace ambitions, contributing to self-reliance, innovation, and export competitiveness. SP

PHOTOGRAPHS: EMBRAER, SP GUIDE PUBNS

THE PEARL SERIES WAS DESIGNED TO DELIVER MORE THRUST, GREATER EFFICIENCY, LOWER EMISSIONS, AND UNMATCHED RELIABILITY

PEARL ENGINE FAMILY — POWERING THE LEADING BUSINESS JETS

Power, Efficiency, and Innovation is how the Rolls-Royce Pearl Engine Series deliver the ultimate propulsion systems for modern business jets

By ROHIT GOEL

FOR MORE THAN SIXTY YEARS, ROLLS-ROYCE HAS ESTABLISHED itself as the world's leading engine supplier in business aviation, powering many of the longest-range business jets in operation. Over 4,000 business aircraft equipped with Rolls-Royce engines are in service across the globe, enhancing business efficiency, productivity, and fostering economic growth. Rolls-Royce engines enable airframers to deliver an ideal blend of speed, range, size, efficiency, and reliability.

As jet propulsion emerged, Rolls-Royce continued to lead, and develop engines, making it one of the world's leading suppliers for business jets engines. This legacy of innovation, reliability, and performance has also been embodied in the latest and most advanced family of business aviation engines of Rolls-Royce, the Pearl series. The Pearl engine family represents the culmination of Rolls-Royce's expertise in jet propulsion, combining proven technologies from the acclaimed BR700 series with

> "The Pearl engine family is part of the Rolls-Royce IntelligentEngine vision of a future where product and service become indistinguishable thanks to advancements in digital capability."
>
> **— Lindsey Stuss Gillen, Vice President Sales & Marketing – Business Aviation, Rolls-Royce**
>
> *(as told to SP's Aviation in an interview published in issue 4 of 2025)*

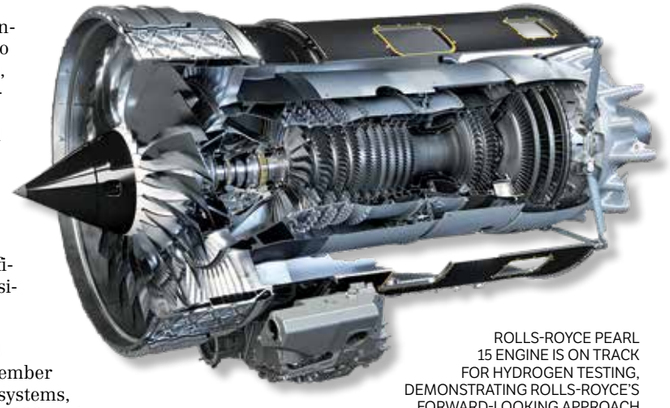
PHOTOGRAPHS: ROLLS-ROYCE

PEARL 15 PROGRAMME TIMELINE

- **2015** — Pearl 15 First Ground Run (Development Phase Begins)
- **2018** — Certification Achieved
- **MAY 28, 2018** — Engine Unveiled; Highlights Include 43:1 Pressure Ratio and 7 per cent SFC Reduction
- **2019** — Enters Service on Bombardier Global 5500 & 6500
- **2021** — **AUGUST 2021** 100th Pearl 15 Engine Delivered
- **2024-2025** — Modified Pearl 15 on Track for Hydrogen Testing

cutting-edge advancements from the Advance2 demonstrator programme. The Pearl series was designed to meet the demands of modern business jet operators, delivering more thrust, greater efficiency, lower emissions, and unmatched reliability.

The Pearl engine family that comprises the Pearl 10X, Pearl 15, and Pearl 700, exemplifies this commitment to design and engineering excellence. Developed to power leading business aviation aircraft, including the Bombardier Global 5500 and 6500, Dassault Falcon 10X, and Gulfstream G700 and G800, these engines deliver the performance, efficiency, and innovation demanded by the modern business aviation sector.



ROLLS-ROYCE PEARL 15 ENGINE IS ON TRACK FOR HYDROGEN TESTING, DEMONSTRATING ROLLS-ROYCE'S FORWARD-LOOKING APPROACH

PEARL 15: NEXT-GEN POWER FOR BOMBARDIER JETS

The Rolls-Royce Pearl 15 engine stands as the first member of a new generation of business aviation propulsion systems, specifically designed to power Bombardier's Global 5500 and 6500 aircraft. The Pearl 15 combines exceptional design with innovative technologies that enable these jets to fly farther, faster, cleaner, and quieter.

At its core, the Pearl 15 features an engine core developed from Rolls-Royce's Advance2 technology demonstrator programmes. This includes a 10-stage high-pressure compressor with six titanium blisked stages, advanced materials, and a design that achieves a record-level overall pressure ratio of 43:1. The engine also has a bypass ratio of 4.8:1 and delivers thrust of up to 15,125 pounds at ISA +15 conditions, enabling the Global 5500 and 6500 to reach top speeds of Mach 0.90.

Efficiency gains are significant, with the Pearl 15 achieving a 7 per cent reduction in specific fuel consumption compared to previous engines. This efficiency is complemented by quieter operation and lower emissions, supporting Bombardier's commitment to cleaner business aviation. Furthermore, the Pearl 15 is on track for hydrogen testing, demonstrating Rolls-Royce's forward-looking approach to sustainable propulsion.

KEY FEATURES OF THE ROLLS-ROYCE PEARL 15

- **Exclusive Power for Bombardier Global 5500 & 6500:** Designed specifically for these ultra-long-range business jets, enabling them to fly farther, faster, cleaner, and quieter
- **Advanced Engine Core:** Features a new 10-stage high-pressure compressor with six titanium blisked stages, based on Advance2 demonstrator technology
- **High Performance:** Delivers up to 15,125 lbf thrust (ISA +15), with an overall pressure ratio of 43:1 and bypass ratio of 4.8:1
- **Efficiency:** Achieves a 7 per cent reduction in specific fuel consumption over previous generation engines
- **Ultra-Low Emissions Combustor:** Incorporates a newly designed tiled combustion chamber and advanced cooling technology for cleaner operation
- **Intelligent Health Monitoring:** Equipped with a next-generation Engine Vibration Health Monitoring System, utilising digital analytics for predictive maintenance
- **Materials and Durability:** Uses advanced nickel alloys, ceramic coatings, and high-temperature materials for enhanced efficiency and longevity

The Pearl 15 embodies Rolls-Royce's IntelligentEngine vision, incorporating the world's most advanced engine health monitoring system. This system harnesses digital capabilities, including big data and cloud-based analytics, to make intelligent decisions that improve engine availability and reliability. The next-generation Engine Vibration Health Monitoring System represents a step change in predictive maintenance and operational efficiency.

Since its first run, the Pearl 15 has undergone rigorous testing and development. It received certification in 2018 and entered service shortly thereafter, powering Bombardier's Global 5500 and 6500 jets. By August 2021, Rolls-Royce had delivered its 100th Pearl 15 engine, marking a milestone in the programme's success.

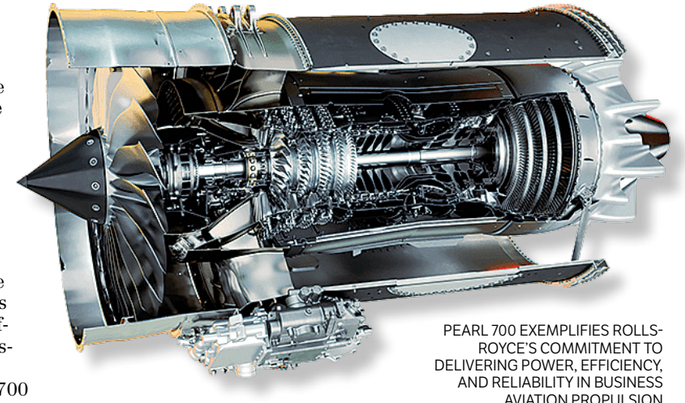
PEARL 700: PUSHING BOUNDARIES WITH GULFSTREAM

The Rolls-Royce Pearl 700 is developed exclusively for the

PEARL 700 PROGRAMME TIMELINE

- **2022** — Received EASA Type Certification (September 2022)
- **2023** — Received FAA Type Certification (September 2022)
- **2024** — Entry into service with Gulfstream G700 supporting ultra-long-range missions

Gulfstream G700 and G800 aircraft. The Pearl 700 combines maximum efficiency and advanced technology to deliver outstanding performance for these ultra-long-range business jets. At its core, the Pearl 700 features the Advance2 engine core, the most efficient core available across the business aviation sector paired with a brand-new low-pressure system. This combination results in an 8 per cent increase in takeoff thrust, delivering 18,250 pounds of thrust compared to the BR725 engine. The engine also offers a 12 per cent better thrust-to-weight ratio and a 5 per cent improvement in specific fuel consumption, all while maintaining class-leading low noise and emissions performance. This powerful propulsion enables Gulfstream's G700 and G800 to fly ultra-long-range missions at speeds close to the speed of sound.



PEARL 700 EXEMPLIFIES ROLLS-ROYCE'S COMMITMENT TO DELIVERING POWER, EFFICIENCY, AND RELIABILITY IN BUSINESS AVIATION PROPULSION

The Pearl 700's design integrates trusted BR700 architecture with innovative technologies from Rolls-Royce's Advance2 portfolio. It features a blisked fan with 24 blades, reducing weight and drag to enhance efficiency. The 10-stage lightweight high-pressure compressor incorporates six titanium blisks and achieves a record 24:1 pressure ratio. The engine's ultra-low emissions combustor employs greener technology and lowers noise emissions. Its two-stage high-pressure turbine uses a shroudless blade design with enhanced aerodynamics and blade cooling, while the enhanced four-stage low-pressure turbine enables higher fan power for increased thrust.

Additional design highlights include state-of-the-art 3D airfoil geometry, 360° low-weight cast stators, and a new ultra slim-line nacelle that is aerodynamically optimised. The nacelle also features a target door thrust reverser and maximised acoustic treatment to minimise noise, alongside optimised packaging to facilitate integration.

KEY FEATURES OF THE ROLLS-ROYCE PEARL 700

- **Exclusive for Gulfstream G700 & G800:** Developed specifically to power Gulfstream's latest ultra-long-range business jets
- **Advance2 Engine Core:** The most efficient core in business aviation, paired with a new low-pressure system for maximum performance
- **Thrust:** 18,250 lbf takeoff thrust—an 8 per cent increase over the BR725 engine
- **Efficiency:** 5 per cent improvement in specific fuel consumption and a 12 per cent better thrust-to-weight ratio
- **Low Noise & Emissions:** Ultra-low emissions combustor and maximised acoustic treatment for the lowest possible noise levels
- **Innovative Design:** Blisked fan with 24 blades, 10-stage high-pressure compressor with six titanium blisks, 24:1 pressure ratio, and aerodynamically optimised slim-line nacelle

The Pearl 700 has been tested and certified, receiving European Union Aviation Safety Agency (EASA) type certification in September 2022 and Federal Aviation Administration (FAA) certification in 2023. The engine has passed all critical safety and durability tests, including bird-strike, cross-wind, ice, hail, water ingestion, and fan blade containment.

As the exclusive engine for Gulfstream's G700 and G800, the Pearl 700 exemplifies Rolls-Royce's commitment to delivering power, efficiency, and reliability in business aviation propulsion, enabling these aircraft to achieve new milestones in speed, range, and environmental performance.

PEARL 10X: RECORD THRUST FOR DASSAULT'S FLAGSHIP

Rolls-Royce's Pearl 10X engine stands at the forefront of business aviation propulsion, purpose-built to power Dassault's new flagship, the Falcon 10X. As the third and most powerful member of the Pearl engine family, the Pearl 10X represents a major leap in both performance and efficiency, setting new benchmarks for the industry.

At its core, the Pearl 10X features the Advance2 engine core, recognised as the most efficient core available in the business aviation sector. This advanced core, paired with a high-perfor-

PEARL 10X PROGRAMME TIMELINE

- **2021** — Pearl 10X Announced as Exclusive Engine for Dassault Falcon 10X (May 6, 2021)
- **2022-2023** — Extensive Ground Testing, Including Validation of 3D-printed Combustor and Accessory Gearbox
- **2023** — Surpassed Target Thrust Levels on First Test run; over 2,300 hours of Ground and Engine Testing Completed
- **2024** — Flight Test Campaign Launched on Rolls-Royce's Boeing 747 Flying Testbed in Tucson, Arizona
- **2025** — Most Major Certification Tests Completed; Engine Advances Toward Final Certification and Entry into Service with Falcon 10X

mance low-pressure system, enables the Pearl 10X to deliver more than 18,000 pounds of thrust, making it the most powerful business aviation engine ever produced by Rolls-Royce. This significant thrust output not only ensures the Falcon 10X's ultra-long-range capabilities but also supports near-supersonic cruise speeds and premium airport accessibility.

Efficiency is a defining characteristic of the Pearl 10X. The engine achieves a 5 per cent reduction in specific fuel consumption compared to the previous generation of Rolls-Royce business aviation engines, a gain that translates directly into lower operating costs and reduced emissions. A key innovation contributing to this efficiency is the use of 3D-printed combustor tiles, manufactured using Additive Layer Manufacturing (ALM), a first for any Rolls-Royce production engine. This technology allows for highly complex cooling passages and geometry, resulting in an ultra-low emissions combustor that is fully compatible with 100 per cent Sustainable Aviation Fuel (SAF).

THE ABILITY OF PEARL 10X TO OPERATE ON 100 PER CENT SAF FURTHER POSITIONS IT AS A FORWARD- LOOKING SOLUTION FOR OPERATORS

KEY FEATURES OF THE ROLLS-ROYCE PEARL 10X

- **Advance2 Engine Core:** The most efficient core in business aviation, delivering superior fuel efficiency and performance.
- **>18,000 lbf Thrust:** The highest thrust output in the Pearl engine family, enabling ultra-long-range and near-supersonic flight.
- **5 per cent SFC Reduction:** Achieves a 5 per cent reduction in specific fuel consumption (SFC) compared to previous Rolls-Royce business aviation engines.
- **100 per cent SAF Compatibility:** Fully tested and capable of operating on 100 per cent SAF, supporting industry sustainability goals.
- **3D-Printed Combustor Tiles:** First Rolls-Royce engine to use Additive Layer Manufacturing for combustor tiles, improving cooling, durability, and emissions.
- **Enhanced Accessory Gearbox:** Allows for higher additional power extraction to support advanced onboard systems.
- **Ultra-Low Emissions:** Features a next-generation combustor designed for minimal environmental impact.
- **CorporateCare Enhanced Support:** Backed by Rolls-Royce's global maintenance and support programme for maximum uptime and reliability.

The Pearl 10X's development programme has been both comprehensive and rigorous. The engine has already accumulated more than 2,300 hours of testing, both on the Advance2 demonstrator and in the Pearl 10X configuration. More recently, the Pearl 10X accrued 3400 test hours in the programme. Ground tests have validated the engine's new ALM combustor and accessory gearbox, which enables higher additional power extraction to support advanced onboard systems. The flight test campaign, conducted on Rolls-Royce's dedicated Boeing 747 flying testbed based in Tucson, Arizona, is a critical phase in the certification process. This campaign includes engine performance and handling checks at a range of speeds and altitudes, inflight relight procedures, nacelle anti-icing tests, and fan vibration assessments.

The Pearl 10X is also the first Rolls-Royce engine ever selected to power a Dassault business jet, marking a significant milestone for both companies. Dassault's choice of the Pearl 10X for its Falcon 10X underscores the engine's market-leading combination of power, efficiency, and environmental performance. The engine's ability to operate on 100 per cent SAF further positions it as a forward-looking solution for operators committed to sustainability.

The Rolls-Royce Pearl engine series stands as a beacon of what is possible when heritage, innovation, and vision converge. For operators and passengers alike, Pearl-powered business jets offer not only unmatched performance and comfort, but also the assurance of flying with the world's most advanced and environmentally responsible engines. As the demands of global business travel continue to evolve, the Pearl family ensures that Rolls-Royce remains synonymous with excellence—today, tomorrow, and for generations to come. SP

GROUP CAPTION SHUBHANSHU SHUKLA UPON HIS SAFE RETURN TO EARTH. HIS MISSION ON BOARD AXIOM-4 HAS ESTABLISHED A CLEAR PATH FOR INDIA'S PROGRESS TOWARDS INDEPENDENT SPACE TRAVEL.

PHOTOGRAPHS: AXIOM_SPACE / X, SPACEX / X

AXIOM-4: PERFECT PACIFIC OCEAN SPLASHDOWN

India caps landmark space mission, ISRO to step up next — Gaganyaan & space station

By MANISH KUMAR JHA

JULY 15, 2025 MARKS THE CONCLUSION OF AXIOM MISSION 4 with the safe splashdown of the Dragon "Grace" capsule carrying Group Captain Shubhanshu Shukla, Poland's Slawosz Uznanski, Hungary's Tibor Kapu, and NASA veteran Peggy Whitson in the Pacific Ocean off California.

For India, Shukla's return is far more than symbolic—it's the first time an astronaut has stepped aboard the ISS and returned in over four decades since Rakesh Sharma's historic flight in 1984.

Prime Minister Modi also lauded India's historic space milestone in his tweet: "I join the nation in welcoming Group

(TOP) THE 4 ASTRONAUTS TAKING OFF ON AXIOM-4 MISSION; ON BOARD THE ISS WITH OTHER ASTRONAUTS ALREADY STATIONED THERE; (ABOVE) PRIME MINISTER MODI TALKING TO SHUBHANSHU SHUKLA DURING HIS STAY AT THE INTERNATIONAL SPACE STATION (ISS).

PHOTOGRAPHS: SPACEX / X, JONNYKIMUSA / X, PIB

Captain Shubhanshu Shukla as he returns to Earth from his historic mission to Space. As India's first astronaut to have visited the International Space Station, he has inspired a billion dreams through his dedication, courage and pioneering spirit. It marks another milestone towards our own Human Space Flight Mission - Gaganyaan."

His 18-day stay, during which he conducted seven ISRO experiments—including growing fenugreek and studying muscle regeneration—paves the way for the upcoming Gaganyaan mission in 2027.

Shukla's successful mission strengthens India's standing in commercial spaceflight, fosters deeper international collaboration, and provides invaluable experience in astronaut training, microgravity operations, and human spaceflight readiness—crucial foundations as India charts its own path in crewed space exploration. Indian astronaut Group Captain Shubhanshu Shukla successfully piloted his Axiom Mission 4 (Ax-4) crew members back to Earth as they splashed down off the coast of San Diego at 3.01 p.m. IST. The crew had departed from the orbiting laboratory on July 14 onboard the SpaceX Dragon.

> "I join the nation in welcoming Group Captain Shubhanshu Shukla as he returns to Earth from his historic mission to Space. As India's first astronaut to have visited the International Space Station, he has inspired a billion dreams through his dedication, courage and pioneering spirit" —Prime Minister Narendra Modi

The Dragon "Grace" capsule, carrying Group Captain Shubhanshu Shukla of the Indian Air Force and three international colleagues, undocked from the ISS at 4:35 p.m. IST on July 14 and commenced its return to Earth, with a scheduled splashdown off California's coast around 3 PM IST on July 15.

SCIENTIFIC TRIUMPHS & RESEARCH BREAKTHROUGHS

The Ax-4 research complement includes around 60 scientific studies and activities representing 31 countries, including the US, India, Poland, Hungary, Saudi Arabia, Brazil, Nigeria, UAE, and nations across Europe. According to the official mission team for Ax-4, this will be the most research and science-related activities conducted on an Axiom Space mission aboard the International Space Station to date, underscoring the mission's global significance and collaborative nature to advance microgravity research in low-Earth orbit (LEO).

The mission scientists have elaborated that the mission emphasises scientific portfolios led by the US, India, Poland (in partnership with ESA), and Hungary. It aims to boost participation in these countries by involving diverse stakeholders, showcasing the value of microgravity research. The studies will focus on human research, Earth observation, life, biological, and material sciences, demonstrating the space research capabilities of the crew's home nations.

Shukla—fondly called "Shux"—conducted seven Indian-designed microgravity experiments, with four already completed and three nearing completion. Key highlights include:

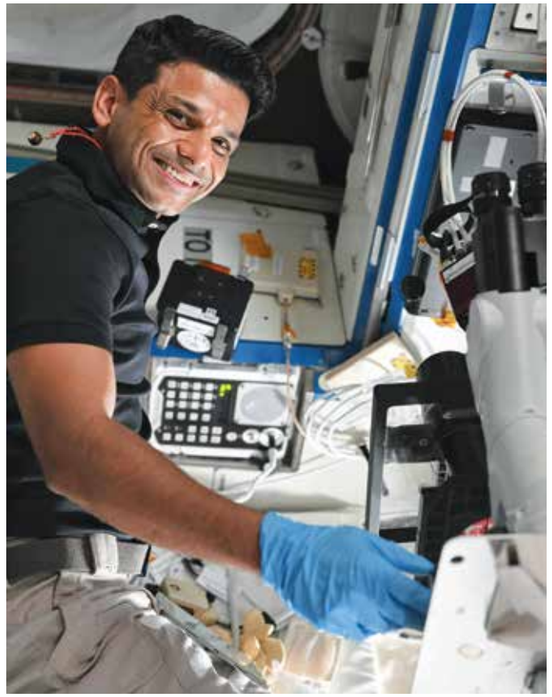
- **Sprouts & Crop Seeds:** Germination of moong, methi, and other crops in microgravity—vital for sustainable space farming.
- **Myogenesis:** Studying muscle-cell regeneration to counter astronaut atrophy and support long-duration missions.
- **Microalgae & Cyanobacteria:** Growth experiments investigating oxygen production, food supply, and bio-regeneration in closed-environment habitats.
- **Tardigrades:** Resilience study of water bears in extreme conditions, with potential applications in radiation protection.
- **Voyager Displays:** Human–machine interface testing that evaluates verbal and cognitive performance in zero-G.
- **Health & Metabolism:** Research on bone health, radiation effects, and even glucose metabolism (diabetes study) under microgravity.

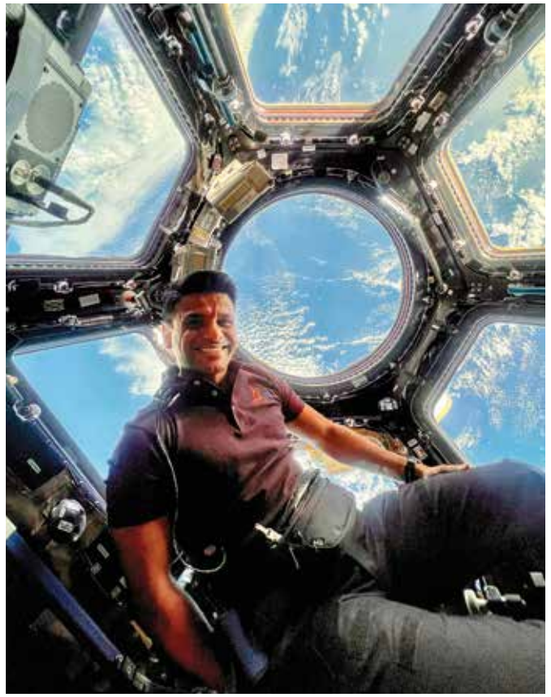
> His 18-day stay, during which he conducted seven ISRO experiments—including growing fenugreek and studying muscle regeneration—paves the way for the upcoming Gaganyaan mission in 2027

These experiments not only provide immediate insights for life sciences but also lay the groundwork for Gaganyaan, India's first indigenous crewed mission, by validating critical systems for human health, nutrition, and habitability in space.

WHAT IT MEANS FOR GAGANYAAN

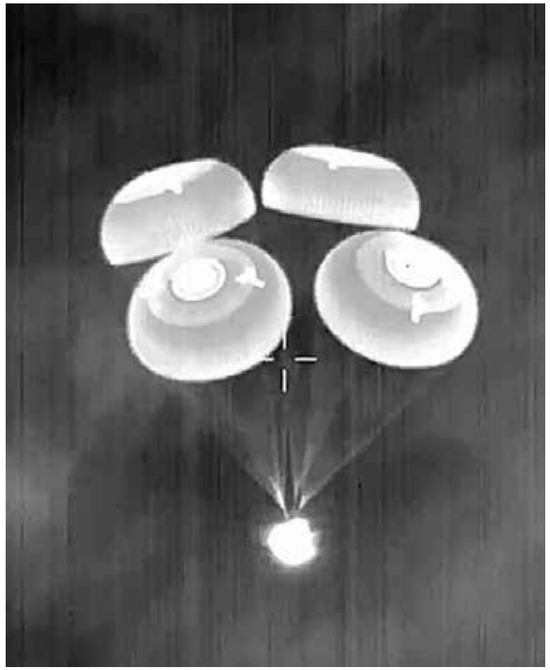
The success of Axiom-4 offers a treasure trove of learnings for Gaganyaan, slated for 2027–28. ISRO has announced plans to launch Gaganyaan - the country's first-ever human space flight in 2027 - and has ambitious plans to set up a space station by 2035 and send an astronaut to the Moon by 2040. Group Captain Shukla is among four Indian Air Force officers shortlisted last year to travel





(LEFT-RIGHT) GROUP CAPTAIN SHUBHANSHU SHUKLA CONDUCTED EXPERIMENTS ONBOARD THE ISS THAT ALSO LAY THE GROUNDWORK FOR GAGANYAAN, INDIA'S FIRST INDIGENOUS CREWED MISSION, BY VALIDATING CRITICAL SYSTEMS FOR HUMAN HEALTH, NUTRITION, AND HABITABILITY IN SPACE

PHOTOGRAPHS: NASA, SHUBHANSHU SHUKLA / ISRO



(LEFT-RIGHT) TOUCH DOWN! THE GRACE, THE DRAGON CAPSULE CARRYING SHUBHANSHU SHUKLA AND THREE INTERNATIONAL COLLEAGUES, HAD A PERFECT SPLASHDOWN OFF CALIFORNIA'S COAST

PHOTOGRAPHS: AXIOM_SPACE / X

on Gaganyaan. Through hands-on experience in uncrewed coordination, health monitoring, experiment handling, crew-ground communications, and spacecraft docking, Shukla has effectively tested and reported back systems that are cornerstones of a sustained Indian human spaceflight programme.

ISRO's own statement underlines this outcome: experiments on microgravity biology, plant science, human physiology, and interface design will directly support Gaganyaan and the upcoming Bharatiya Antariksha Station.

> For India, Shukla's return is far more than symbolic—it's the first time an astronaut has stepped aboard the ISS and returned in over four decades since Rakesh Sharma's historic flight in 1984

WHAT'S NEXT? INDIA'S SPACEFLIGHT ROADMAP

The immediate step, as is the norm in most of the successful space journeys, is for the astronaut, including Shubhanshu Shukla's rehabilitation and data analysis.

After splashdown, Shukla will undergo a week-long medical and physiological rehabilitation overseen by ISRO and NASA partners. Scientific samples will be returned to India for detailed laboratory analysis, particularly from completed experiments like Myogenesis and Microalgae.

The next phase would be dedicated to Gaganyaan Crew Preparation. Insights from Grace's crew-ground dynamics and experiment outcomes will refine astronaut selection, training protocols, spacecraft interfaces, sensor systems, and biomedical preparedness for Gaganyaan.

LAUNCH OF GAGANYAAN MISSION

India is targeting a crewed launch between 2027 and 2028, utilising the Gaganyaan spacecraft and LVM3 rocket to send three Indian astronauts into low Earth orbit. Axiom-4's findings will be pivotal to ensuring mission safety, crew health, and operational readiness.

By safely returning Shubhanshu Shukla and scientific findings from microgravity, Axiom-4 has established a clear path for India's progress towards independent space travel. As scientific samples and data come back home, India's Gaganyaan mission is ready to launch—with increased confidence, validated systems, and a new generation of astronauts prepared to follow. SP

Manish Kumar Jha is a Consulting & Contributing Editor for SP's Aviation, SP's Land Forces and SP's Naval Forces and a security expert. He writes on national security, military technology, strategic affairs & policies.

UNLOCKING GROWTH

Proposing Alternative Tax Revenue Solution to Help Grow India's Business Aviation Sector

By **SANJAY JULKA,**
CEO TECHNICAL, CLUB ONE AIR

INDIA'S BUSINESS AVIATION SECTOR HAS LONG CALLED FOR parity in import tax treatment across commercial operations, Non-Scheduled Operator Permits (NSOPs), and private aircraft. Despite ongoing engagement with the Directorate General of Civil Aviation (DGCA) and the Ministry of Civil Aviation, progress has been sluggish. High import duties continue to stifle growth.

A more constructive path forward lies in advocating for duty exemptions for NSOP and private aircraft while proposing an operations-based taxation model. This approach could address industry concerns without reducing government revenues.

THE CONSEQUENCES OF THE CURRENT TAX REGIME

The existing tax differential has led to several structural inefficiencies:

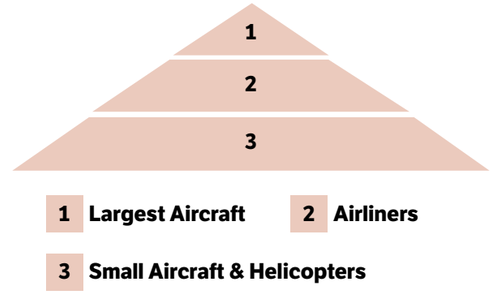
- **Distorted Charter Pricing:** Almost all private aircraft owners have opened NSOPs only to save heavy import duties. Therefore, aircraft charter rates are arbitrarily set, often based on cost recovery rather than market-driven profitability, making it difficult for commercially focused operators to remain competitive.
- **Underdeveloped Management Models:** India lacks distinct owner-operator and aircraft management company frameworks. Unlike developed countries where aircraft can be owned by someone wanting to invest into Aviation but managed by professional operators, current DGCA rules force even single-aircraft owners to set up NSOPs, leading to unnecessary fragmentation. Presently, 122 NSOPs manage just 400 aircraft—an inefficient use of resources and manpower. The moot reason is disparity in import duty. In an environment that already faces a shortage of experienced professionals, this fragmentation could hinder the high growth rate anticipated for the aviation sector. Additionally, the resulting inefficiencies drive up operational expenses and place an increased burden on the regulator, potentially impacting safety standards.
- **Constraints on Fractional Ownership:** The import tax disparity has also stifled innovative ownership models like

> Given India's democratic and socio-political context, taxing the luxury component of business aviation alone offers a pragmatic and progressive path

INDIA'S AIRCRAFT FLEET: AN INVERTED PYRAMID

India's Aircraft Fleet: An Inverted Pyramid. The base is Small Aircraft & Helicopters (550), then Airliners (750). Statista 2023-2024.

US AIRCRAFT FLEET COMPOSITION: A PYRAMID PERSPECTIVE



The US aircraft fleet visualized as a pyramid. The base is General Aviation (205,000), then Airliners (7,300), the peak being Largest Aircraft (400), per FAA 2023 statistics

Fractional Ownership. Such concepts, though in great demand in the west, have not seen the light of the day in India, primarily because the Government has not been able to find a solution on how to address the disparity in the import duties. Without addressing this disparity, fractional ownership may not be possible in India.

- **Demand far outstrip Supply:** Demand has far outstripped supply over the past several years. India, with over 250 billionaires, operates only 200 business jets compared to the USA's 15,000 for 600 billionaires. Small aircraft, which are crucial for regional connectivity and economic upliftment, are disproportionately underrepresented.

> A more constructive path forward lies in advocating for duty exemptions for NSOP and private aircraft while proposing an operations-based taxation model

SMALL AIRCRAFT AS CATALYSTS FOR GROWTH

- Aviation growth often follows a bottom-up model: small aircraft initiate connectivity to emerging regions, paving the way for commercial carriers. The Raigarh case exemplifies how air connectivity transforms cities, supporting industrial development, tourism, and emergency services. (https://www.sps-aviation.com/bizavindiasupplement/story/?id=69&h=Aviation-Catapults-Raigarh-to-Next-Level)
- Yet, the public perception that business aviation is a luxury rather than a necessity continues to undermine its developmental role. This misperception has led to an inverted pyramid—too few small aircraft and a heavy reliance on large airliners—slowing down route development and regional connectivity.

A CONSTRUCTIVE ALTERNATIVE: TAX OPERATIONS, NOT IMPORTS

While both the DGCA and Ministry of Civil Aviation recognise the harm caused by import taxes, the Ministry of Finance remains unmoved, insisting on alternative revenue sources.

This article proposes a new approach: offering the Government an alternative revenue source that, once implemented, will remove barriers to models such as separate owner-operator systems, aircraft management concept and fractional ownership, and avoid excessive fragmentation in the process. This, in turn, would resolve regulatory overload and the shortage of experienced manpower, paving the way for a renaissance in India's business aviation industry—creating the ideal pyramid structure. It is recommended that, instead of taxing imports, taxes should be collected based on operations.

LET US SEE HOW?

Import tax is recommended to be reduced to zero, as it was in 2007 and as is common in many developed economies. This measure would eliminate the inconsistencies discussed above and, could potentially triple the growth of business aircraft.

The removal of import taxes would inevitably result in a loss of revenue for the Government. To address this, it is suggested to shift the tax burden to aviation operations. Importantly, the proposed operational tax should target only those flights undertaken for convenience or luxury purposes. It is unfair to tax operations related to public services—such as medical or religious tourism, law enforcement, firefighting, or emergency support to civil authorities. Additionally, flights to unserved airports should be exempt from this tax, while those to underserved or well-served airports should incur a rate higher than the current GST. The tables provided below offers a detailed illustration of this proposal.

ASSUMPTIONS

DEFINITION OF AIRPORTS

Unserved Airfields	Underserved Airfields	Well Served Airfields
No scheduled flight	Upto 1 scheduled flight morning and evening each from a given DGCA Flight Information Regions (FIRs)	More than 1 scheduled flight morning and evening from a given FIR

DISTRIBUTION OF AIRCRAFT IN THE COUNTRY

		Total	INR Cr	17	42.5	85	170	425
A	Existing	400	%	20%	30%	30%	16%	4%
B	Current Nos of Yearly Induction	25	B*C	5	7.5	7.5	4	1
C	NSOP	–	%	96%	96%	96%	96%	96%
D	Private	–	%	4%	4%	4%	4%	4%
E	Expected Induction in Proposed "Zero Taxes on Import Regime"	75	B*F	15	22.5	22.5	12	3

PROPOSAL

REVENUE TO GOVERNMENT ON IMPORT, UNDER CURRENT REGIME

			Tax Collected at Import (Customs Duty and IGST where ITC is not permitted)							
			INR Cr	17	42.5	85	170	425	Total	Grand Total
F	NSOP	2.80%	C*D*A*F	2.28	8.57	17.14	18.28	11.42	57.69	–
G	Private	32%	C*E*A*G	1.09	4.08	8.16	8.70	5.44	27.47	85.16

COMPARISON OF TAX COLLECTED ON OPERATIONS: CURRENT VS PROPOSED "ZERO TAXES ON IMPORT REGIME"

				Medical	Religious	Other Public Use	Unserved areas	Under-served areas	Well served areas	Total
H	Percentage of Flights	–	%	10%	7.50%	7.50%	10%	25%	40%	–
I	Hours per aircraft	–	h	500	500	500	500	500	500	–
J	Approx Charter rate	–	INR	250000	200000	150000	325000	400000	650000	–
K	Total hours flown	–	(B+C)*H*I*D	20400	15300	15300	20400	51000	81600	**204000**
L	GST Collected	–	%	0	5	18	18	18	18	–
M	GST Collected	INR Cr	L%*K*J*10^-7	0	15.3	41.31	119.34	367.2	954.72	**1497.87**
N	Total hours flown in proposed regime incl Private	–	(B+F)*H*I	23750	17812.5	17812.5	23750	59375	**95000**	237500
O	GST in proposed regime	–	%	0	0	0	0	18	24	–
P	GST in proposed regime	INR Cr	O%*N*J*10^-7	0	0	0	0	427.5	1482	**1909.5**
Q	Extra Tax Collected in proposed regime	INR Cr	P-M	–	–	–		–	–	**411.63**
				Extra Revenue to Government						
R	Extra Revenue collected in proposed regime	INR Cr	Q-G	–	–	–	–	–	–	**326.47**

Note: The data used in this analysis is based on the author's experience and is approximate. Exact figures are not crucial here; the purpose is to illustrate that the Government has an alternate revenue source available, one that eliminates all the growth woes due adverse effects associated with import taxes.

EXCERPTS FROM "INDUSTRY REPORT BY BUSINESS AIRCRAFT OPERATORS ASSOCIATION (BAOA) PREPARED ALONG WITH MARTIN CONSULTING, 2016

DIRECT CONTRIBUTION TO GDP/ PROJECTED ANNUAL LOSS (RS CR) DUE TO RETARDED GROWTH

Year	As is Growth (2%)	Best Growth as per demand (12%)	GDP Contribution Lost
2020	1451 Cr	1722 Cr	**271 Cr**
2025	1505 Cr	2344 Cr	**829 Cr**
2030	1557 Cr	3319 Cr	**1762 Cr**

It is significant to note from the above "loss analysis" that if the current business environment is not supported with corrective measures, then by 2030, the Indian economy will miss out on more than 1700 Cr worth of direct contribution to its GDP on an annual basis. This is more than the total "Direct" contribution of the sector to the GDP currently.

For the moment we have refrained from quantifying the projection of the Indirect and induced component contributions of the industry's GVA (Gross Value Added) to India's GDP.

CONCLUSION

The BAOA report clearly demonstrates that removing import duties can drive growth. As an interim solution, the proposed operations tax ensures continued revenue generation while avoiding the current system's distortions. This may be the answer that Finance Ministry may have been looking for.

- **Shift Tax Burden to Operations:** Instead of taxing imports, impose taxes on well-served routes, ensuring no loss to government revenue.
- **Enable New Ownership Models:** Removing import taxes will pave the way for fractional ownership, separate owner-operator concept, aircraft management companies, and reduced load on regulator by consolidation of NSOPs.
- **Accelerate Industry Growth:** The new taxation model will drive rapid expansion in business aviation aircraft and helicopters, enhancing connectivity and economic development.

Given India's democratic and socio-political context, taxing the luxury component of business aviation alone offers a pragmatic and progressive path. Even a modest increase in fleet size under the new model could generate greater revenue than existing import taxes, while simultaneously unleashing the sector's full potential. SP

THE 2025 PARIS AIR SHOW SHOWCASED THE LATEST ADVANCEMENTS IN CIVIL AVIATION, DEFENCE, AND SPACE WHILE UNDERSCORING THE AEROSPACE INDUSTRY'S COMMITMENT TO INNOVATION AND SUSTAINABILITY

PHOTOGRAPH: PARISAIRSHOWTV

INNOVATION, DEALS, AND SUSTAINABLE SKIES

From major commercial deals to cutting-edge defence, digital security, and space ventures, Paris Air Show 2025 displayed the unfolding of Aviation's next chapter and shifting focus of global aerospace

By SP'S SPECIAL CORRESPONDENT

FOR MORE THAN A CENTURY, THE INTERNATIONAL PARIS Air Show at Le Bourget has stood as a beacon for the global aerospace industry, a place where innovation takes flight, and the future of aviation is shaped. The 55th edition of the show, held from June 16 to 22, 2025, showcased the latest advancements in civil aviation, defence, and space, providing a unique platform for the unveiling of new aircraft, satellites, propulsion systems, armaments, and flight assistance technologies. It is a place where some of the industry's biggest deals are struck, strategic alliances are forged, and the technological roadmap for the coming years is set.

Officially inaugurated by French Prime Minister François Bayrou on June 16, the 2025 Paris Air Show (PAS) was recognised as a major national event. The presence of President Emmanuel Macron on June 20, along with 15 French ministers and secretaries of state, underscored the event's importance not only to France but to the global aerospace community.

This year's show attracted a record over 3,05,000 visitors. The exhibition hosted 2,400 exhibitors from 48 countries, including 1,124 French companies and 136 startups. The scale of the event was further emphasised by 332 chalets. Over 150 aircraft were displayed, with 173 flight demonstrations. The show's reach extended to 400 official delegations (civilian and military) from France and abroad.

2400	305 200	136	155	70
Exhibitors from 48 countries	Unique Visitors	Start-ups	Aircraft and 173. flying displays	Hectares of exhibition

Among the 400 delegations were 80 civil delegations invited by the French Ministry of Transport, representing 64 countries and five international organisations. For the first time, a delegation from the International Civil Aviation Organisation (ICAO) attended, led by its President and Secretary General. The civil sector was further represented by 12 civil aviation ministers and 62 directors general of civil aviation.

On the military side, 174 official delegations attended at the invitation of the French Ministry of the Armed Forces, representing 77 countries and five international organisations. These included 17 ministers, nine deputy ministers or secretaries of state, 36 chiefs of staff, and 26 directors general of armament. Additionally, 149 other institutional delegations, both French and international, participated, including 20 from EU institutions, three from NATO, and several from the European Commission.

The show featured numerous events aimed at promoting dialogue, spreading scientific and industrial culture, and strengthening the appeal of a sector that innovates, creates value, decarbonises, ensures defence and security, and trains and recruits widely.

Notable public events at the show included the Paris Space Hub, the Paris Air Lab and the Start-Me-Up. Initiatives like L'Aéro Recrute and the Women in Aerospace and Space programme highlighted the sector's commitment to inclusivity and diversity. Space exploration took center stage in 2025 with the launch of the Paris Space Hub, a brand-new setting that offered an immersive journey into the latest achievements in satellite technology, lunar exploration, and scientific breakthroughs. Apart from insightful talks and the display of technology, attendees could also participate in a virtual reality space adventure, donning VR headsets to explore Mars, Saturn, and the cosmos in stunning detail.

The 2025 Paris Air Lab spotlighted some key challenges and innovations in air transport, from AI, cybersecurity, and quantum tech to sustainable fuels, electrification, and hydrogen, through interactive exhibits on ultra-efficient aircraft, light aviation, and new air mobility concepts. As a united, forward-looking showcase within the Paris Air Show, it underscored the aerospace sector's ambitions and the transformative "fourth revolution" underway.

India marked the 2025 Paris Air Show, with the presence of 18 organisations, led by Defence Research and Development Organisation (DRDO) and Hindustan Aeronautics Limited (HAL), showcasing indigenous defence systems like the Tejas Mk-2, Astra missile, and NETRA Airborne Early Warning and Control (AEW&C). The private sector also stepped up, with major collaborations such as Wipro's acquisition of France's Lauak Group, Reliance-Dassault's Falcon 2000 line in Nagpur, and Tata Consultancy Services's (TCS) AI-driven MRO solutions, signalling India's ambition to become a global hub for defence innovation and manufacturing.

AIRCRAFT DISPLAYS AND AERIAL DEMONSTRATIONS

A defining feature of the Paris Air Show is its remarkable display of aircraft. In 2025, 155 aircraft were exhibited, and 173 flight demonstrations showcased the latest in aviation technology. The lineup reflected a mix of historic aircraft and next-gen platforms, signaling the industry's transition from tradition to future-ready solutions.

Displays included the, A220, A400M, Boeing 777X, Dassault Flamant, ATR 72-600, Embraer E175, Eurofighter Typhoon, NH90, Airbus Racer, JMB VL3 Turbiner, and advanced drones. Aircraft like the Airbus Racer and electric propulsion systems drew attention, underlining the industry's commitment to sustainability. Military aviation occupied ~45 per cent of the show space, with strong focus on air and missile defence, ISR platforms, and integration of unmanned systems with legacy aircraft.

DEALS, CONTRACTS & STRATEGIC PARTNERSHIPS

- Airbus emerged as the dominant force in commercial aviation, securing 248 firm orders and 156 options. Major deals included Riyadh Air's $9 billion order for 25 A350-1000s, AviLease's mixed order of A320neos and A350Fs worth nearly $7 billion, and VietJet's $6.3 billion deal for 100 A321neos. With total aircraft orders down from 2023, Airbus's wide-ranging contracts from global carriers underscored strong market confidence in its latest single-aisle and long-haul aircraft.
- Boeing confirmed 41 firm orders and four options. All of these orders came from ANA Holdings of Japan, which ordered 23 Boeing 787-9 Dreamliners and 18 737 MAX 8 aircraft, along with four options, reflecting a subdued presence for Boeing at the event.
- Embraer reported 79 firm orders and 60 options, highlighted by a 60-aircraft order from SkyWest Airlines for the E175, to be operated for Delta, American, and United. The Brazilian manufacturer also logged smaller military commitments, including a C-390 order from Portugal and three Letter of Intents (LoIs) from Lithuania, in a deal valued at $3.6 billion and deliveries beginning in 2027. Embraer and ANA finalised a deal for 15 E190-E2s, marking ANA's first order for Embraer aircraft.
- ATR, the turboprop specialist, signed a deal with JSX for two ATR 42-600s and a letter of intent (LoI) for 15 new ATR Highline-equipped aircraft, plus 10 options.

THE 55TH EDITION OF INTERNATIONAL PARIS AIR SHOW 2025 WAS A GRAND CONVERGENCE OF AEROSPACE EXCELLENCE, UNFOLDING AVIATION'S NEXT CHAPTER

PHOTOGRAPHS: PARISAIRSHOWTV, ARCHER

- SkyWest Airlines placed a $3.6 billion order for 60 Embraer E175s, with options for 50 more, solidifying its status as the largest E-Jet operator.
- De Havilland Aircraft received orders for a Twin Otter Classic 300-G and two Dash 8-400 freighter conversion kits.
- Dassault Aviation and Reliance Aerostructure aim to assemble Falcon 2000LXS business jets in India, marking the first Falcon manufacturing outside France.
- Bombardier Global 7500 set a new speed record flying from Montréal to Paris for the show.
- Archer Aviation secured a $250 million agreement for up to 50 Midnight eVTOLs with Indonesia's IKN.
- Otto Aviation received a $500 million incentive for its Phantom 3500 business jet manufacturing facility in Florida.
- Textron Aviation showcased the modular design of its King Air platform and announced a strategic partnership with Leonardo for the M-346.
- Safran Helicopter Engines, MTU Aero Engines, and Avio Aero formalised their partnership to develop a next-generation engine for Europe's future military helicopters.
- Textron Aviation Defence and Thai Aviation Industries agreed to develop a sustainment programme for the Royal Thai Air Force's T-6TH and AT-6TH Wolverine aircraft.
- Airbus Helicopters and Leonardo launched a study for the NH90 Block 2 upgrade, focusing on modular avionics and new capabilities.
- FN presented new external gun systems for Sikorsky HH-60W helicopters.

SUSTAINABILITY & FUTURE OF AIR TRANSPORTATION

At the 2025 Paris Air Show, sustainability was again in focus, integrating environmental goals into strategies, technologies, and investments. Sustainable Aviation Fuel (SAF) gained momentum with long-term supply deals, while partnerships like ATR-ATOBA and TotalEnergies-Quatra aligned supply chains for greener operations. Hydrogen technologies moved from labs to flight-testing, backed by UK government grants and industry collaborations. Public-private efforts, such as the launch of ARIS, underscored the need for cross-sector cooperation on zero-emission aircraft and digital airspace.

(LEFT-RIGHT) MILITARY AVIATION OCCUPIED AROUND 45 PER CENT OF THE SHOW SPACE; THE PARIS AIR LAB SPOTLIGHTED KEY INNOVATIONS IN AIR TRANSPORT.

- France's aerospace, defence, and security innovation cluster SAFE signed a strategic partnership with the Garde nationale, focused on mobilising civilian resources to support national security objectives.
- GKN Aerospace extended its engine component repair contract with Pratt & Whitney to 2029 and expanded collaboration with Archer Aviation for eVTOL airframe components.
- Airbus, BoostAeroSpace, Collins Aerospace, Liebherr, and Thales launched DECADE-X, a nonprofit to develop a interoperable digital ecosystem for aerospace and defence.
- Leonardo and Bombardier Defence began exploring collaboration on maritime multi-mission aircraft.
- Safran and Bombardier signed a letter of intent to jointly develop defence technologies.
- Collins Aerospace Advanced Structures showcased innovations in lightweight, durable, and fuel-efficient materials.

DEFENCE & SECURITY

- Lockheed Martin showcased a 40 per cent year-on-year increase in tactical missile output, focusing on production and scale rather than prototypes. Its new "Joint Fires" architecture integrates sensors from platforms like F-35s and satellites with missile systems in real-time targeting networks.
- NHIndustries showcased the NH90 Multi Role Frigate Helicopter variant for the German Navy.

Highlights included a surge in fuel-efficient aircraft orders, Airbus's unveiling of a 1.2 MW hydrogen fuel-cell system, and breakthroughs in electric and hybrid propulsion from companies like MagniX and ZeroAvia. Lockheed Martin Skunk Works is supporting Electra Aero's hybrid-electric EL9 STOL aircraft. Beta Technologies' Alia CX300 electric aircraft debuted, with Republic Airways set to use it for pilot training and route planning. Elfly's Noemi electric seaplane moved closer to certification with a pre-application contract signed with EASA. Wisk Aero expanded its eVTOL air taxi partnerships to Miami and Kaga, Japan.

The 2025 Paris Air Show underscored the aerospace industry's commitment to innovation, sustainability, and strategic collaboration. As new technologies transition from concept to reality, the event highlighted a dynamic future for both civil and defence aviation. Though geopolitical conflicts evidently influenced the tone of the show, it also highlighted global partnerships deepening through aviation. With significant commercial deals and pioneering demonstrations, the show reinforced its role as a catalyst for progress in the skies. Looking ahead, the advancements unveiled at Paris are likely to shape the trajectory of aerospace for years to come. SP

for detailed show report, kindly visit: www.sps-aviation.com/features

PHOTOGRAPH: PARISAIRSHOWTV

MIL MI-8: THE MOST PRODUCED HELICOPTER IN HISTORY

When the Mi-8 was first displayed at the 1965 Paris Air Show, it created a sensation. Western analysts had long considered Soviet technology inferior to that of the West, but the comments about the Mi-8 were mainly positive.

THE MIL MI-8 IS A VERSATILE, MEDIUM-LIFT, TWIN-TURBINE helicopter, in widespread use in both military and civilian roles, particularly as a transport helicopter. It holds the distinction of being the most produced helicopter ever. The design of this iconic machine was drawn up in the 1950s by the Mil Design Bureau, headed by Mikhail Mil. Mil believed that gas turbine engines would revolutionise helicopter construction and make a breakthrough both in flight performance and economic efficiency. During over six decades of production, perhaps 17,000 Mi-8s have been delivered to around 80 countries worldwide. 'Eights', as they are colloquially called, are still being built, and continue in service all over the world. Both Russia and Ukraine utilise them in their ongoing conflict.

The Mi-8 story began with Soviet Prime Minister Nikita Khrushchev who, on a visit to the USA in September 1959, was taken on a trip aboard the US presidential helicopter. This was the age of intense superpower rivalry, when the refrain was, "Anything you can do, I can do better!" Khrushchev wanted something to impress the US president on his reciprocal visit to the Soviet Union. In the meantime, the Soviet military, was also planning a new and better machine to replace the existing Mi-4. Consequently, a team of developers soon got to work on the proposed helicopter.

The Mi-8 took off for the first time on June 24, 1961. It was the civilian sector that first began to exploit the new machine. It was only when the Bell UH-1helicopter proved a great asset to the United States during the Vietnam War that the Soviet military rushed a troop-carrying variant of the Mi-8 into production. By 1967, the first military variant entered service with the Soviet Air Force.

When the Mi-8 was first displayed at the 1965 Paris Air Show, it created a sensation. Western analysts had long considered Soviet technology inferior to that of the West, but the comments about the Mi-8 were mainly positive. Indeed, the Mi-8 was a well-designed aircraft with outstanding flight performance and the ability to fly in extreme weather conditions. It had good ergonomics for both crew and passengers and a spacious and comfortable cargo compartment. And its five blade main rotor reduced noise and vibration significantly.

A worldwide sales tour for the aircraft followed and it netted a number of overseas orders. With demand surging, another series production facility was set up in Ulan-Ude in 1970. In the 1970s the Mi-8 was fitted with more powerful twin Klimov TV3-117MT turboshaft engines of 1,454 kW (1,950 hp) each. With these engines, it has a max speed of 250 km/h, range of 495 km, and service ceiling of 5,000 m. Its payload capacity is 24 passengers, or up to 4,000 kg of cargo, or weaponry on up to six hard points. Latest models can carry up to 5,000 kg. It has a crew of three: a pilot, co-pilot/navigator and a flight engineer.

If there is a job that needs a helicopter, the Mi-8 can probably do it. Not for nothing is it called the 'hundred professions' helicopter since it has appeared in over a hundred variants and derivatives. Its roles include personnel and armament transportation, search and rescue, medevac, fire support, suppression of adversary firing positions, mine laying, aerial refuelling, and electronic warfare. There is even an amphibious variant for naval use. A dedicated export variant, the Mi-17, was produced from the 1980s onwards. It was basically a Mi-8 with more power and a new tail rotor.

The Mi-8 arrived in India in 1971 and was inducted in 1972. The IAF procured a total of 107 Mi-8s between 1971 and 1988. Between 2008 and 2013, 151 Mi-17 helicopters were also purchased, primarily for operations in the mountains. Mi-8s and Mi-17s have proved invaluable in major IAF operations like Operation Meghdoot and Operation Pawan as well as humanitarian and disaster relief missions. They are also employed in the VIP/VVIP transport role as well as the training role. The Mi-8 was formally phased out of the IAF inventory by December 2017. However, the IAF still operates three variants of the Mi-17, including the latest Mi-17V5, which form the backbone of its medium-lift helicopter fleet.

One of the strengths of the Mi-8 is that its design has continually evolved to keep pace with changing times and new requirements. Take the Mi-8MTV-5-1 that has been in service with the Russian military since 2011. One of its main features is that it can fly and navigate even in the complete absence of light. The IAF's Mi-17V-5 helicopter too is equipped with night vision technology, on-board weather radar, a new PKV-8 autopilot system, and a KNEI-8 avionics suite, which has a clear and intuitive cockpit, with four large multi-functional displays that are easy to read and help reduce pilot fatigue. SP

— JOSEPH NORONHA

MILITARY

DEFENCE MINISTER AT CONTROLLERS' CONFERENCE 2025

Defence Minister Rajnath Singh addressed the Controllers' Conference of the Defence Accounts Department (DAD) in New Delhi on July 7, 2025, emphasising the department's critical role in strengthening the operational readiness and financial agility of the Armed Forces. Referring to the success of Operation Sindoor, he stated that the valour displayed and demonstration of the capability of domestic equipment has further increased the global demand for the indigenous products. He also called on the DAD to evolve from a 'controller' to a 'facilitator' in sync with increasing participation of the private sector in defence.

Highlighting the increasing strategic and economic significance of the defence sector, Rajnath Singh called for a shift in perception from defence spending as mere expenditure to an economic investment with multiplier impact. He urged the department to incorporate Defence Economics in their planning and assessments, including social impact analysis of R&D projects and dual-use technologies.

SUCCESSFUL FLIGHT-TEST OF ASTRA BVRAAM

Defence Research & Development Organisation (DRDO) & Indian Air Force (IAF) successfully conducted the flight-test of indigenous Beyond Visual Range Air-to-Air missile (BVRAAM) 'Astra' equipped with indigenous Radio Frequency (RF) Seeker from Su-30 MKI platform on July 11, 2025. During the tests, two launches were carried out against high-speed unmanned aerial targets at different ranges, target aspects and launch platform conditions. In both the cases, the missiles destroyed the targets with pin-point accuracy.

Astra BVRAAM has a range exceeding 100 kms and is equipped with state-of-the art guidance and navigation system. In addition to various laboratories of DRDO, more than 50 public and private industries have contributed towards successful realisation of the weapon system.

GA-ASI ADDS SAAB AEW CAPABILITY TO MQ-9B

General Atomics Aeronautical Systems, Inc. (GA-ASI) is partnering with Saab to develop Airborne Early Warning and Control (AEW&C) capability for its line of MQ-9B Remotely Piloted Aircraft, which includes the SkyGuardian® and SeaGuardian® models, the United Kingdom's Protector, and the new MQ-9B STOL (Short Takeoff and Landing) model currently in development. GA-ASI plans to fly AEW on MQ-9B in 2026.

GA-ASI will pair Saab's AEW sensors with the world's longest-range, highest-endurance unmanned aircraft system (UAS), the MQ-9B. At sea or over land, the AEW mission package on MQ-9B will put air dominance within reach at a lower cost than legacy platforms.

The MQ-9B AEW solution will offer critical aloft sensing to defend against tactical air, guided missiles, drones, and other threats at a fraction of the cost of manned platforms. Operational availability for medium-altitude long-endurance UAS is the highest of any military aircraft, and as an unmanned platform, its aircrew are not put into harm's way. AEW for MQ-9B will augment existing AEW fleets by extending their effective ranges. It also gives air forces that need AEW, but lack legacy platforms, a powerful and affordable means to counter threats.

BOEING NAMES STEPHEN PARKER AS CEO OF DEFENSE, SPACE & SECURITY

BOEING ANNOUNCED Stephen (Steve) Parker as President and Chief Executive Officer of its Defense, Space & Security (BDS) business, effective immediately. Parker has served as interim leader of the Boeing business unit since September 2024.

STEPHEN PARKER, CEO OF DEFENSE, SPACE & SECURITY, BOEING

"Under Steve's leadership, our defence business has stabilised its operations, improved programme execution and strengthened relationships with our customers," said Boeing President and CEO Kelly Ortberg. "With proven experience in manufacturing and programme management, combined with his focus on developing people and building a strong culture, Steve is a leader who exemplifies the best of Boeing."

Parker will report to Ortberg and serve on the company's Executive Council. Parker will oversee all aspects of the company's business unit that provides technology, products and solutions for defence, government, space and intelligence customers worldwide.

Parker was previously BDS Chief Operating Officer, responsible for day-to-day business operations overseeing teams that include quality, manufacturing and safety, supply chain and programme management. Before that, Parker led BDS divisions including Bombers & Fighters and Vertical Lift, and oversaw teams that developed many of the most innovative products and solutions across Boeing's defence portfolio. He also managed Boeing Defence Australia, the company's largest subsidiary outside the US Parker joined Boeing in 1988. SP

EMBRAER CELEBRATES DELIVERY OF THE THIRD KC-390 AND MAIDEN FLIGHT OF THE A-29N

EMBRAER AND PORTUGUESE AIR FORCE (FAP) celebrated the delivery of the third KC-390 Millennium aircraft to the FAP and the launch of the A-29N flight test campaign, which included a historic joint flight of both aircraft.

The third KC-390 is part of an agreement between Embraer and the Portuguese government that will ultimately result in six aircraft in operation, with an additional ten purchase options available for allied and NATO (North Atlantic Treaty Organization) nations. The first A-29N is part of a 2024 order for 12 aircraft, making Portugal the launch customer for the Super Tucano variant designed to meet NATO requirements.

"We are extremely proud to contribute meaningfully to enhancing the FAP's operational capabilities with both the KC-390 and the A-29N. This delivery and joint flight represent major milestones that reflect our commitment to supporting Portugal's defence with efficient and innovative solutions, always grounded in our strong, long-term partnership," said Bosco da Costa Junior, President and CEO of Embraer Defense & Security.

This game-changing KC-390 Millennium aircraft fully meets NATO standards and requirements. In addition to Portugal, several European and NATO allies – including Hungary, the Netherlands, Austria, the Czech Republic, Sweden, Slovakia, and Lithuania – have selected the KC-390 to modernize their air forces. In total, 11 countries have chosen this state-of-the-art aircraft, including Brazil and South Korea.

FAP'S A-29N AND KC-390 MILLENNIUM

The A-29 Super Tucano is a versatile and proven aircraft offering exceptional operational flexibility. The A-29N Super Tucano variant will feature advanced avionics, NATO-specific communication systems, and other undisclosed capabilities tailored to meet NATO's operational needs. SP

APACHE FOR INDIAN ARMY

MILESTONE MOMENT FOR INDIAN ARMY AS THE FIRST BATCH OF APACHE HELICOPTERS FOR ARMY AVIATION ARRIVE IN INDIA. THESE STATE-OF-THE-ART PLATFORMS WILL BOLSTER THE OPERATIONAL CAPABILITIES OF THE INDIAN ARMY SIGNIFICANTLY.

CIVIL

D328ECO® TEST AIRCRAFT ROLLS OUT

Deutsche Aircraft has proudly unveiled the first D328eco test aircraft (TAC 1) at their headquarters, a transformative moment for sustainable regional aviation. Following the announcement of the initial fuselage cut at the Farnborough International Airshow in July 2024, the programme has maintained steady momentum as it drives progress towards a more efficient and environmentally conscious future for regional air travel.

Building upon the proven legacy of the Dornier 328, the D328eco is an advanced evolution, not a clean-sheet aircraft. It delivers enhanced performance, fuel efficiency, an elevated customer experience and lower emissions, while retaining the versatility and reliability that airlines, operators and passengers have trusted for over three decades. The roll out of the test aircraft underscores Deutsche Aircraft's commitment to innovation, decarbonisation and regional connectivity.

ZEROAVA TO BUILD MANUFACTURING HUB IN SCOTLAND

ZeroAvia announced that it will build a major manufacturing facility for production of its hydrogen-electric powertrains at the Advanced Manufacturing Innovation District Scotland, close to Glasgow Airport in Renfrewshire.

ZeroAvia's Hydrogen Centre of Excellence will support the company in a range of manufacturing operations relating to powertrain production and testing and will also be the company's primary location for production of advanced high temperature PEM (HTPEM) fuel cell stacks and supporting systems. With nearly 3,000 full engine and component orders agreed with airlines and OEMs – corresponding to over $10 billion in future revenues - ZeroAvia is advancing its production operations to meet demand.

UNI AIR SIGNS ORDER FOR 19 ATR 72-600S

ATR announced that UNI Air, a group company of EVA Air, has placed a firm order for 19 ATR 72-600s, along with three additional purchase rights. This marks ATR's largest airline order since 2017, and the second direct order from UNI Air since 2011, when the Taiwanese

APPOINTMENTS

AIR MARSHAL S. SIVAKUMAR ASSUMED THE APPOINTMENT OF AIR OFFICER-IN-CHARGE ADMINISTRATION (AOA)

The Air Marshal was commissioned in Administration branch of the Indian Air Force in June 1990. In a career spanning over 35 years, the Air Marshal has held a number of important Command and Staff appointments which include Assistant Chief of Air Staff (Air Force Works) at Air Headquarters and Senior Officer-in-Charge Administration of an Operational Command. Before assuming the present appointment, the Air Marshal was Director General (Administration) at Air HQ.

SALES DIRECTOR FOR MULTI-ROLE AIRCRAFT, DEUTSCHE AIRCRAFT

Markus Hahner has been appointed as Sales Director for Multi-Role Aircraft, Deutsche Aircraft.

Markus joins them from Leonardo Germany, where he has served since 2017 in a senior business development capacity. His previous roles include consultancy and leadership positions at German MoD's in-house consultancy and the first German drone company, serving German Forces, where he contributed to innovation in unmanned aerial systems and defence process optimisation.

CEO OF MTU AERO ENGINES AG

Dr Johannes Bussmann will take over as CEO of MTU Aero Engines AG on September 1, 2025. He will join the Executive Board of the company on July 15, 2025. MTU's Supervisory Board announced Bussmann as the new, incoming CEO at the end of 2024, and has now set the timeline for this change.

Dr Johannes Bussmann is currently CEO of TÜV SÜD AG and previously headed Lufthansa Technik AG. Bussmann has been appointed to the MTU Aero Engines AG Executive Board for a five-year term. His mandate will run until July 14, 2030.

airline purchased 10 ATR 72-600s. It serves as a clear testament of UNI Air's and affiliated company EVA Air's trust in ATR turboprops to serve the Taiwanese domestic market efficiently. Deliveries are scheduled between 2027 and 2032.

These 19 brand-new aircraft will replace and expand UNI Air's current fleet of 14 ATR 72-600s, marking a significant step in the airline's modernisation and growth. Equipped with new generation PW127XT engines, an updated cabin design, and a New Air Management System, these latest-generation aircraft will strengthen UNI Air's operations and competitive positioning, through improved fuel efficiency, lower maintenance costs, enhanced reliability and upgraded passenger experience.

AIRAVAT AND FLY SIRIUS UNITE UNDER NEW BRAND

Dubai's Airavat and India's Fly Sirius, renowned for their bespoke private jet charter services, announced their rebranding to Transworld Jets. This strategic move marks a significant milestone, aligning the brands with their parent company, Transworld Group, a global leader in logistics, shipping, and integrated supply chain solutions. The rebranding is a key initiative in the company's growth journey, aimed at enhancing brand coherence across international markets and reinforcing its commitment to delivering seamless, world-class aviation experiences. The new identity, Transworld Jets, emphasises the company's dedication to global excellence, bespoke services, and forward-thinking innovation in the larger aviation space.

BOEING AND QATAR AIRWAYS ANNOUNCE HISTORIC ORDER

Qatar Airways and Boeing announced the carrier will purchase up to 210 widebody jets, which sets new records as the largest widebody order for Boeing, including the largest order for 787 Dreamliners and Qatar Airways largest-ever order. This purchase, which also includes additional orders for Boeing's new 777-9, will support approximately 4,00,000 jobs in the US and position the award-winning Middle Eastern airline for further international expansion.

The order includes 130x 787 Dreamliners, 30x 777-9s, and options for an additional 50x 787 and 777X airplanes.

SEVENTH HELICOPTER & SMALL AIRCRAFT SUMMIT HELD IN PUNE

The Ministry of Civil Aviation, in collaboration with the State Government of Maharashtra, Pawan Hans and FICCI, organised the 7th Helicopter & Small Aircraft Summit in Pune. In his keynote address, Union Minister Rammohan Naidu Kinjarapu shared his vision to promote helicopters and small aircraft as essential components of a futuristic aviation ecosystem. The Minister announced the establishment of a dedicated Helicopter Directorate under the DGCA to provide single-window regulatory oversight, address helicopter-specific safety and certification issues, and assist operators with procedural requirements. He highlighted digital initiatives like the Heli Sewa Portal, which have streamlined operations and digitised processes such as route approvals and slot allocations, significantly enhancing transparency and efficiency. The summit also saw the award of RCS UDAN helicopter routes across various states.

The summit witnessed active participation from 20 State Governments, industry leaders, IFSCA (GIFT City), the National Disaster Management Authority (NDMA) and senior officials from the Ministry of Civil Aviation, DGCA, AAI and Pawan Hans Ltd.

SAS PLACES RECORD ORDER FOR 55 EMBRAER AIRCRAFT

Scandinavian Airlines (SAS) has entered into an agreement to acquire 45 Embraer E195-E2 aircraft, with purchase rights for an additional 10 aircraft — the largest SAS jet order direct from a manufacturer since 1996. This milestone agreement supports SAS' long-term fleet renewal strategy, which is focused on increasing efficiency, reducing emissions, and unlocking future growth opportunities from its global hub in Copenhagen as well as across its Scandinavian and international network. The first aircraft deliveries from Embraer are scheduled to begin in late 2027, with further deliveries extending over approximately four years. Excluding purchase rights, the value for the order is approximately $4 billion.

PLANS TO EXPLORE HYDROGEN EVTOL PROPULSION

ZeroAvia and Horizon Aircraft announced plans to work together on developing regional hydrogen-electric VTOL air travel. Together, the companies will cooperate on exploring ZeroAvia's ZA600 hydrogen-electric powertrain for Horizon Aircraft's Cavorite X7 eVTOL. The Cavorite X7's unique fan-in-wing design incorporates 14 lift fans providing the thrust for vertical takeoff, with sliding panels which hide the fans as the aircraft transitions from hover to wing-borne flight and flies like a normal plane. For landing, it can use a normal runway, or the fans can be deployed to touchdown on a helipad, or an area the size of a tennis court. Horizon Aircraft has already performed untethered flight tests of a large-scale prototype, including demonstrating hover modes and transition to wing-borne flight. The company has received backing from the US Department of Defence and approvals for flight testing from the Canadian regulator. As well as investigating the integration of ZeroAvia's powertrain, the partnership will accelerate research into the necessary infrastructure and certification guidelines to unlock a zero-emission pathway for Horizon Aircraft.

BUILDING ON EXCELLENCE

YOU ASKED FOR MORE – WE DELIVERED.

CORPORATECARE® ENHANCED

Our unmatched support network dedicated only to business aviation is strategically placed around the globe, providing customers access to excellent service and parts in any region.

85 on-wing services technicians

25 customer managers

85 authorized service centers

24/7 aircraft availability center

250 and growing lease engine and nacelle assets

10 spares locations

ROLLS ROYCE

Building on excellence. **Rolls-Royce**.

Rolls-Royce.com/enhanced