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AN EXCLUSIVE MAGAZINE ON CIVIL AVIATION FROM INDIA

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Embarking on a sustainable journey and soaring into green skies, Aviation takes flight for the future with innovative efforts towards Net Zero.

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The future of regional travel is being redefined by ATR's revolutionary and innovative turboprops

Pratt & Whitney stands at the forefront of aerospace innovation, propelling a journey from legacy to sustainability, characterised by pioneering excellence in aerospace propulsion, shaping the future of global aviation

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60 1964-2024 YEARS OF SP'S

SP Guide Publications takes flight in 2024, marking 60 years of shaping the aviation landscape! We are eternally grateful to all who have been our companions on this remarkable journey.

Our gaze now, remains firmly fixed on the future. With unwavering passion, unrelenting vigour, and unwavering integrity, we pledge to continue serving the aviation sector with excellence, innovation, and a commitment to pushing boundaries.

In a significant prelude to the announcement of the National Civil Aviation Policy, Prime Minister Modi shared a visionary dream of making flying accessible. This dream birthed the UDAN scheme in October 2016, a crucial component of the National Civil Aviation Policy. Since its inception, 517 RCS routes have become operational, linking 76 airports. The UDAN scheme aims to operationalise 1,000 routes and revitalise 100 unserved and underserved airports, heliports, and water aerodromes by 2024. In its sixth year, the Regional Connectivity Scheme continues to weave connections through UDAN, driving local empowerment and economic growth. Swaati Ketkar provides an insightful overview of RCS in this edition.

Sustainability remains in the limelight! In an article in this issue, Joseph Noronha simplifies SAF, the related technologies, global initiatives, national intentions, the current scenario & the way ahead. Rohit Goel explores ATR's innovative and fuel-efficient turboprops, positioning them as key players in redefining the future of regional travel towards efficiency and sustainability.

Anil Chopra explores the quest for Atmanirbharta in commercial aviation. Despite being the fastest-growing economy and civil aviation market, India is yet to leverage large airliner orders to attract aircraft and engine manufacturers. Chopra advocates for strategic partnerships with the likes of Boeing and Airbus to establish assembly lines in India, tapping into the country's manufacturing and assembly skills.

The issue also analyses the helicopter industry, urging for policies that recognise the versatility of helicopters and align with their unique functionalities. The report emphasises the potential use of helicopters in internal surveillance, law and order maintenance, traffic management, and civic roles under the SMART Cities project. Sukhchain Singh's report spotlights MRO innovations in the digital era, predicting a rapid bloom in demand for maintenance services with the domestic fleet expected to surpass 1,000 by 2027. The digital MRO market, driven by advanced technologies like AI, Digital Twins, AR, Blockchain, Additive Manufacturing, and Cloud Computing, presents new tools for efficient management within reduced budgets. In his report, Dr D.K. Pandey discusses Pratt & Whitney's pivotal role in aerospace innovation and sustainability. The spotlight then shifts to India's air cargo potential, emphasising the significant opportunity for fleet growth relative to the country's GDP. Ryan Weir outlines strategic partnerships between the Indian Government, the aviation industry, and Boeing to harness this economic opportunity.

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

Meet us at Hall C, Stall No. 30 at the Wings India 2024, show in Hyderabad.

Jayant Baranwal
Publisher & Editor-in-Chief

PHOTOGRAPH: pmindia.gov.in

CONNECTING DREAMS, TRANSFORMING LIVES

Six years since launch, the Regional Connectivity Scheme (RCS) continues to connect diverse regions through UDAN, empowering local communities and boosting economies

BY **SWAATI KETKAR**

EVERYONE DREAMS OF TRAVELLING on an aircraft at some point in their lives. Some achieve this dream while doing their jobs, some fulfil this dream as a part of their dream vacation with loved one's but for many, especially the economically weaker sections of the society were getting one square meal is a daily struggle, this dream always just remains a dream. It is for such people that Prime Minister Narendra Modi had a focussed vision named–'Regional Connectivity- UDAN scheme.' This one-of-a-kind scheme was brought in to revolutionise air travel in India and completely change the picture of regional air travel. UDAN aims to enable air travel on underserved or unserved routes connection regional areas, promoting balanced regional growth and make flying affordable for the vast and economically poor section of the society.

THE BIRTH OF RCS UDAN - 'UDE DESH KA AAM NAAGRIK'. In an important meeting held before the announcement of the National Civil Aviation Policy, Prime Minister Modi expressed his dream of seeing people wearing slippers on the plane as slippers (Chappal) is considered as a hallmark of a poor man in India. With this dream the UDAN scheme was launched as a vital element of National Civil Aviation Policy in October 2016. Within a year in April 2017, Prime Minister Modi, flagged off the first flight connecting Shimla to Delhi.

"First time in the country, dream of an air travel which is cheaper than taxi got realised. Small towns are connecting with big cities. A common man who travels in slippers, should also be seen in the aircraft. This is my dream," said Prime Minister Modi and soon the UDAN scheme took wings

Smaller airlines, that have come up to provide air connectivity to Tier II and Tier III cities, are integral to the success of UDAN

Since then, till December 2023, 517 RCS routes have commenced operations connecting 76 airports, including nine Heliports & two Water Aerodrome. Going ahead the government plans to operationalise 1,000 UDAN routes and to revive/develop 100 unserved & underserved airports/heliports/water aerodromes by 2024 for operation of UDAN flights. About INR 3,751 crores have been utilised out of INR 4,500 crores allocated for the development of airports under UDAN.

IS UDAN SOLELY RESPONSIBLE FOR INDIA'S RISE IN AIR TRAFFIC? "Given the strong GDP growth, with or without the scheme, air traffic in India would have increased anyway perhaps a shade lighter, but the growth would have been there," comments Arun Kumar Singh, former Chief Executive and Accountable Manager of IndiaOne Air. He even shared some very interesting statistics.

In 2016 when UDAN was launched, the domestic air traffic was about 1,15,609 from scheduled and non-scheduled airlines. In the last 85 months, in November 2023 as per the latest data from Directorate General of Civil Aviation's office the total number of domestic passengers rose by 52 per cent, 4,25,635 at a CAGR of 6.1 per cent. Comparatively, in September 2009, 85 months before UDAN kicked in, 1,15,609 domestic passengers were recorded. So, by general comparison between the months, in October 2016 traffic increased by 141.8 per cent at a CAGR of 13.3 per cent as compared to September 2009.

Thus, Kumar draws a simple conclusion from above figures that domestic air travel in relation to historic performance, over similar time period, growth rate has slowed down despite introduction of UDAN. According to Prem Garg, the current Chief Executive of IndiaOne Air, "UDAN was a good start but the overall progress is slow with sustainability issues for smaller standalone airlines. Code sharing model allowed but not working/feasible." He further feels that UDAN has not lived up to its expectation of providing a sustained a competitive market environment in aviation sector.

Vineet Sood, Chief Executive Officer, Alliance Air differs in his opinion of UDAN. According to him: "RCS-UDAN scheme has definitely achieved its objective as flight connectivity has been provided between hinterland and the major metros. By operating flights on these routes people who had not travelled by air have started to travel in order to reduce the journey time," he adds.

T. Kabilan I.D.A.S, Director of the NITI Aayog asserts that UDAN's economic impact needs to be assessed objectively. "It is a good start though, but the necessary ecosystem needs to be prepped up by the states for adequate PPP infra in these areas," Kaliban adds as an afterthought.

UDAN aims to enable air travel on underserved or unserved routes, connecting regional areas, promoting balanced regional growth, and making flying affordable for the economically poor

WHAT EXACTLY IS UDAN? UDAN's main focus is to connect small and medium cities to large metros through fixed wing aircraft. The affordable scheme has a fixed rate of INR 2,500 for one-hour journey by an aircraft or half hour journey by a helicopter for about 500 kilometres.

Aviation companies bid for air routes and the company that asks for the lowest subsidy is awarded the contract. In order to encourage airlines to start operations from unserved or under-

PHOTOGRAPH: CMO_Odisha / X

Airline success stories are being crafted on the back of regional connectivity, unlocking economic growth in previously underserved areas

served airports, heliports, water aerodromes, the government as well as airports offer financial incentives in terms of concessions to keep the air fare affordable. Selected airlines are offered financial support in the form of Viability Gap Funding (VGF). State governments provide 20 per cent while Northeast states and Union Territories offer 10 per cent VGF for RCS flights for their states.

Excise Duty at the rate of 1 per cent / 2 per cent is levied on Aviation Turbine Fuel (ATF) drawn by selected airline at RCS airports for RCS Flights for a period of 3 years from the date of commencement. However, in several cases, VAT and Excise on ATF is not exempted, reduction on operations charges like RNFC, Landing, Parking etc is not given while airlines are forced to pay money to third parties such as SITA.

"Airlines struggle on daily basis to claim their rightful dues, with the Airport Authority (AAI) turning a blind eye to airline's requests," Kumar retorts.

Thus, despite the subsidy offer, several airlines have either failed to launch operations or have abandoned the route after a while. Kumar explains the reasons for this with a three-point approach:

- MoCA and AAI have failed to put a cap on many viable routes that airlines can bid for.
- Due to this several airlines (in spite of being defaulters and not having the means to operate) bid for a high number of routes.
- Even if airline is in the position to commence flights, they are unable to do so since aerodrome is not licensed, navigation aid is missing, has high visibility requirement etc.

"RCS cell must be careful so as not to invite tenders for airports that are not ready for scheduled commercial operations," Kumar signals a warning.

Echoing Kumar's views Garg feels that infrastructure development, flexibility and VGF should focus on number of seats deployed in a quarter and not flights per week. According to Garg:

- eco system development for sustainability of routes after VGF support is withdrawn
- rationalisation of BGs and PGs for small operators
- single window for various applications for parking, space, hanger, stores, counters etc should be given.

Thus, delays in availability of required infrastructure/ airports, regulatory permissions for airline, capital intensive, cash flows, availability of licensed & experience manpower could be some of the reasons why airlines failed to take off on certain routes or abandoned the flights after a few months.

Another pain-point is the 'network viability and aircraft utilisation'. "For financial viability, optimum aircraft utilisation needs to be more than 8 Block hours a day. You see our network, how our networks have been optimised and our aircraft utilisation for day operations," Garg claims.

PHOTOGRAPH: MoCA_GoI / X

Newer airports have come up across the country facilitating air connectivity and travel.
Shown here is the inauguration of the Ayodhya airport by Prime Minister Narendra Modi accompied by Minister of Civil Aviation.

As a solution to the problem, Kaliban feels that route profitability and alignment to right subsidy structure may help newer airlines tide the issue of launching newer routes.

But all hope is not lost, certain airlines like Alliance Air has commenced all the routes awarded to it under RCS 5.0 round. Alliance Air boasts of starting maximum routes awarded to it since the inception of RCS-UDAN scheme. For example, Alliance Air has commenced 111 routes out of the 137 awarded to it. The flights which have not commenced are due to the airports are not being ready yet. "Once these airports are made operational, AAAL will commence flights at the earliest," Sood adds.

Praising Alliance Air of the achievements Sood says, "It is noteworthy that Alliance Air has offered the maximum permissible capacity under airfare capping for the benefit of passengers on RCS routes. It is also encouraging that Alliance Air has not refused to operate any RCS route awarded to it. As on date, Alliance Air operates the highest number of routes under RCS."

HOW HAS UDAN FARED IN REVITALISING ECONOMIES, INFRASTRUCTURE DEVELOPMENT? UDAN has certainly helped to revitalise the local economies and given a big boost to the infrastructure in these cities. "But once the RCS tenure gets over, we see a dip in the travelling public," says Sood. In spite of offering competitive fares and low fares the flights have not recovered their operational cost resulting in withdrawal of flights. "Alliance Air is already in touch with the government officials as well as State government officials to provide relief to the travelling passenger so that tourism and trade can be boosted," Sood further clarifies.

Long term demand generation, sustainability and operational viability of the network after the VGF support is withdrawn is the key. "Ecosystem building in terms of Tourism, business, leisure and improved airport infrastructure is must. Small routes will have to be supported for longer duration (5-7 years) due scalability, operating costs for smaller airlines (less than 10 aircraft) consumer behaviour and operational factors," demands Garg of IndiaOne Air.

"UDAN contribution to developing economies and infrastructure in Tier II and III cities can be called as debatable," argues Kumar. "I started 5 airports in sort span of 10 months. I would have loved to fly with a bigger aircraft however, neither the State Government, nor the Central Government had the vision or the inclination to increase runway length or to make basic infrastructure available."

He further explains his point with a live example. "I was instrumental in getting Jeypore (Odisha) aerodrome licensed. Jeypore is in Koraput district, and for the first time, it got connect by air when we operationalised the airport." Jeypore has a population of 1.5 million, houses HAL, NALCO and other mines. Despite the population, economy and potential, runway length in Jeypore is mere 1,200 meters. Kumar further goes on to express his frustration by saying that this runway length is not sufficient for ATR 72 aircraft; hence a 9-seater aircraft operates two flights a day to

Since its launch, 517 RCS routes have commenced operations, connecting 76 airports, with plans to operationalise 1,000 UDAN routes and revive/develop 100 unserved & underserved airports/heliports/water aerodromes by 2024

PHOTOGRAPH: PIB

TAPPING THE SEAPLANE POTENTIAL

INDIA'S VAST AND DIVERSE coastline and inland lakes remain a treasure trove of untapped potential for the seaplane operations market. The Government of India is keen on exploring the potential of seaplane services in India. On October 31, 2020, the Prime Minister launched a seaplane service in Gujarat which showed that India is making progress in this segment. With the right market diligence, India's long and a beautiful coastline offers the potential to develop both the tourism and transportation segments. India has several positive factors that could potentially benefit the seaplane operations market.

On October 31, 2020, Prime Minister Narendra Modi launched a seaplane service in Gujarat

Few operators in India have demonstrated entrepreneurial initiatives and have tested the seaplane operations market in the past. SpiceShuttle, a subsidiary of SpiceJet, launched seaplane services using a 15-seater Twin Otter 300 aircraft. SpiceJet had secured 18 seaplane routes under the UDAN scheme. Recently, an operator placed a substantial order for electric seaplanes that are planned to be launched in 2029. Hence with the right infrastructure and Governmental support, there are operators who are willing to test waters and start commercial feasible seaplane operations.

The Government of India and State Governments have taken initiatives in the past and continue to do so to promote seaplane operations. Under UDAN 5.0 (2023), the Ministry of Civil Aviation opened up more seaplane routes and also committed to developing seaplane waterdromes. Airport Authority of India (AAI) has sanctioned money for 14 water aerodromes in India. Also, Ministry of Ports, Shipping and Waterways has initiated the process of commencing operations of the Seaplane services, on the select routes. The model will be operated as a hub and spoke system. Further, Kerala Tourism carried out a detailed study to assess the locations and feasibility of seaplane operations within the State.

India has the right framework of regulatory, operations and Government support to explore the potential for seaplane services.With its vast and diverse geography and presence of large coastline and inland lakes, India has the potential to become a large seaplane operations market. SP

Jeypore. "This translates to only 0.005 trips per capita even if all flights go full the entire year. National average is 0.13 and for comparison, China is 0.5. Having airports with such small runways and feeble infrastructure is 'too little too late' and is like applying band-aid on a bullet wound," Kumar adds with exasperation.

Kumar throws light on painpoints like super small runways, no navigation aid, DGCA AAI dragging their feet on GAGAN, stringent security regulations, X-Ray machine etc and unlicensed aerodromes which are huge bottleneck for operations.

Balancing demand and supply demand and commercial viability is a tight rope walk. One of the solutions provided by Kaliban to tide over this tussle is that newer and robust funding models in cost optimisation might help smaller airlines tide through the subsidy period.

WHAT CAN THE GOVERNMENT DO MORE FOR 'AAM NAGRIK' AND 'AAM AIRLINES'? Looking at BOM-DEL as one route and DEL-BOM as another route, then in October 2016 about 304 domestic routes were operational. As per the current figures, in November 2023, total operational routes where at least one person travelled in the entire month was 600. "Now to achieve the target of 1,000 routes, there is a long-list of things that the Ministry of Civil Aviation (MoCA) needs to do," says Kumar. He further goes a step ahead to list out all the to-do thing for the MoCA.

According to Kumar, "The MoCA should entirely revamp the UDAN scheme and take up some share of accountability for the airlines. Currently there is no ownership and accountability in the scheme. Airlines are left on their own to solve their problems." Kumar goes on. He feels the DGCA norms are ambiguous, outdated and drafted keeping in view only the big aircraft.

Today sustainability is one of the most sought-after factors in aviation. Including sustainability as a core pointer in overall development is the need of the hour. "The global players have started it in a big way, its time Indian aviation also embraces sustainability in the aviation sector especially on the fuel front. There can be incentives for firms which bring in such innovation to the sky," Kaliban concludes.

CHALLENGES FOR RCS-UDAN GOING AHEAD. Some of the current challenges observed are lack of infrastructure, low passenger demand, no benefit of cheaper tickets seen by passengers, and lack of awareness about the UDAN scheme, no dedicated platform to book the ticket under UDAN etc. However, Kumar correctly says that it is not government's lookout to sell tickets. "I filled up 80 per cent of my flights despite not being on OTA / GDS. Government should only focus on policy formulation and infrastructure creation," Kumar signs off Garg also feels that government is doing what it takes like collaborating with states and other ministries, businessmen, airports, airlines etc. Patting the MoCA on its back, Garg says: "MoCA & AAI RCS cell is doing good job trying to build up necessary expertise and getting operators on board for better coordination & collaboration."

However, it's healthy mix of infrastructure, use of technology for better reach, ease of business, faster & transparent system wherein cash flow is ensured. "Regulatory monitoring and impact evaluation of the scheme if done correctly will definitely help the ministry and the sector," Kaliban signs off. SP

PHOTOGRAPH: PIB

SAF – GREEN GOLD OR GREENWASH?

Sustainable Aviation Fuel (SAF) is essentially about biomass and waste – including waste CO_2 – being turned into "green gold", or jet fuel, to slash emissions. However, tight supply of raw materials and high production costs make large-scale SAF production challenging.

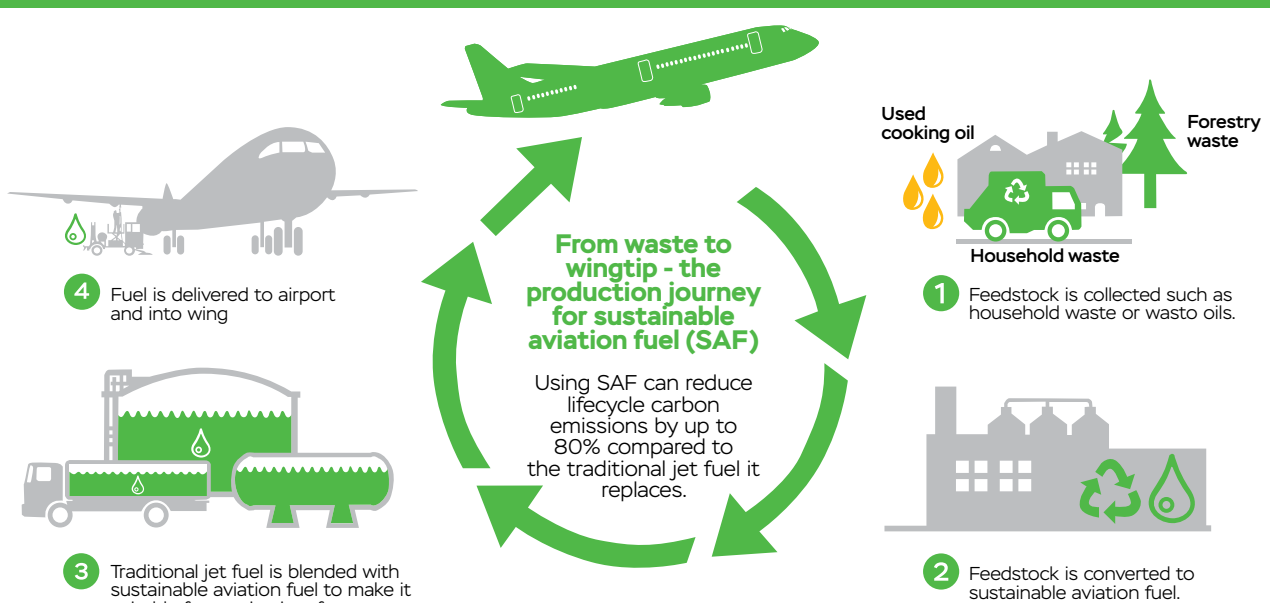
BY **JOSEPH NORONHA**

ALL THE EVIDENCE INDICATES that planet Earth is heating up, and fast. In May 2023, the World Meteorological Organization (WMO) issued a report that projects a 66 per cent likelihood that the world will exceed the internationally agreed 1.5 degrees Celsius threshold within the next four years. Scientists believe that a rise of 1.5 degrees Celsius is a climate change "red line" and overshooting it even for a few years is risky. It may trigger tipping points that cannot be uncrossed – such as the melting of permafrost that would, in turn, release huge amounts of trapped CO_2 and intensify global warming. The UN Secretary-General Antonio Guterres has given a stark warning that the planet is "nearing the point of no return".

The need to switch to greener fuels therefore has never been more urgent. The UN Climate Change Conference (COP28) summit, in Dubai in December 2023, for the first time took explicit aim at the use of fossil fuels and agreed a new commitment to reduce their use. It reemphasised the importance of reaching net zero by 2050 to avert the worst consequences of global warming. Net zero is a state where the amount of greenhouse gases (GHG) produced is balanced by the amount removed from the atmosphere.

Many sectors of the economy are making significant strides in the transition to more environmentally friendly fuels. So is the aviation industry, which currently contributes just 2.5 per cent of global emissions. However, air travel is incredibly difficult to decarbonise and it is still one of the fastest growing sources of emissions. Commercial aviation is rebounding rapidly after COVID-19, and the International Air Transport Association (IATA) anticipates a full recovery this year. By 2025, IATA expects global passenger numbers to reach 4.6 billion and surge to 10 billion by 2050. Fuel consumption will correspondingly balloon. In fact, aviation's share of global emissions could easily triple by 2050.

HOW IS SUSTAINABLE AVIATION FUEL MADE?



Source: Air bp

In 2021, therefore, IATA's member airlines committed to achieve net zero carbon emissions from their operations by 2050. Besides new aircraft technologies, more efficient operations, direct carbon capture (DCC) and credible offsetting schemes, IATA's strategy towards making aviation sustainable rests mainly on Sustainable Aviation Fuel (SAF). Indeed, as much as 65 per cent of the reduction of GHG emissions required to attain the industry's challenging net zero goal is expected to come from SAF.

SIMPLIFYING SAF. SAF is a liquid fuel used in commercial aviation that can reduce lifecycle CO_2 emissions by up to 80 per cent. It is produced from sustainable resources and can be mixed with fossil jet fuel to reduce emissions. The term "sustainable" highlights the fact that the production process does not have a detrimental impact on the environment, since it involves neither deforestation or land use change, nor does it require large amounts of fresh water. It also implies that the feedstock is obtained by focusing on waste-to-fuel and power-to-liquid (PtL) solutions, not by usurping arable land from farmers. It is a "drop-in" fuel, meaning it can be added without changes to the aircraft or infrastructure. According to the Geneva-based Air Transport Action Group (ATAG) over 7,00,000 commercial flights have been operated using SAF since 2011. Across the globe, 69 airports are currently regularly supplied with SAF.

In April 2023, the European Union Commission announced new regulations regarding the use of SAF. They require aviation fuel suppliers to blend a minimum percentage of SAF with traditional jet fuel at EU airports. It will start at 2 per cent in 2025 and increase to 70 per cent by 2050. Other countries are expected to promulgate their own blending targets.

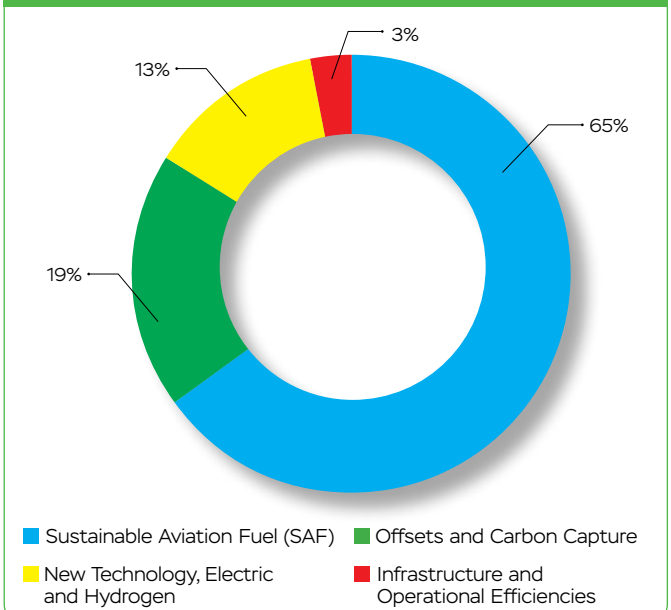
SAF TECHNOLOGIES. SAFs can be produced from a variety of feedstocks (42 at last count) and through several different technologies, each with its own set of challenges. SAF conversion processes are evaluated and approved by organisations such as ASTM International. As of July 2023, 11 conversion processes for SAF production had been approved and seven other conversion processes were under evaluation.

In the PtL process, capturing CO_2 released during combustion and combining it with hydrogen forms a "virtuous circle" in that the CO_2 that is emitted by burning is itself reused to create more fuel

Researchers are continuously developing and refining new ways to create SAF and to produce it at lower cost from an expanding set of technologies and feedstocks.

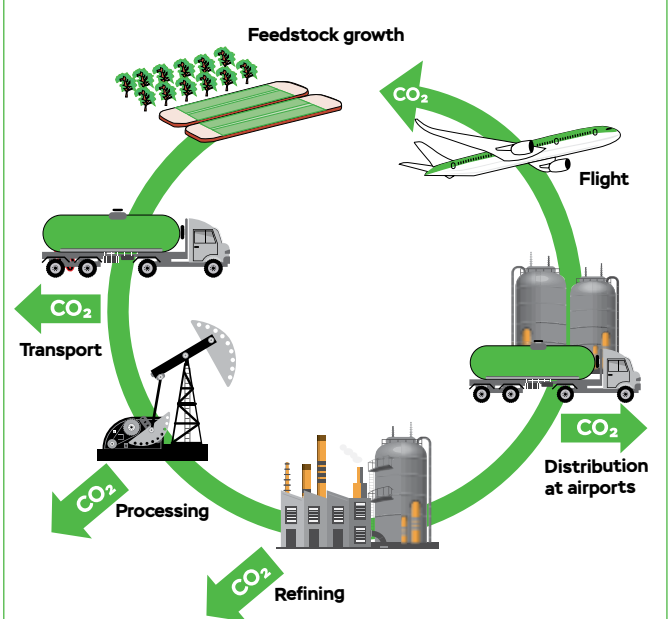
- **First Generation SAFs.** These are the cheapest, simplest to produce and hence most commonly available type. They come from fats, oils and greases (FOGs). They reduce CO_2 emissions by 50 to 80 per cent compared to normal jet fuel over the lifecycle of the product. The obvious problem is limited availability of feedstocks which prevents significant scaling up of production.
- **Second Generation SAFs.** These types of SAF are obtained from biomass and municipal solid waste and can potentially reduce GHG emissions by 85 to 95 per cent over their lifecy-

CONTRIBUTION TO ACHIEVING NET ZERO CARBON IN 2050



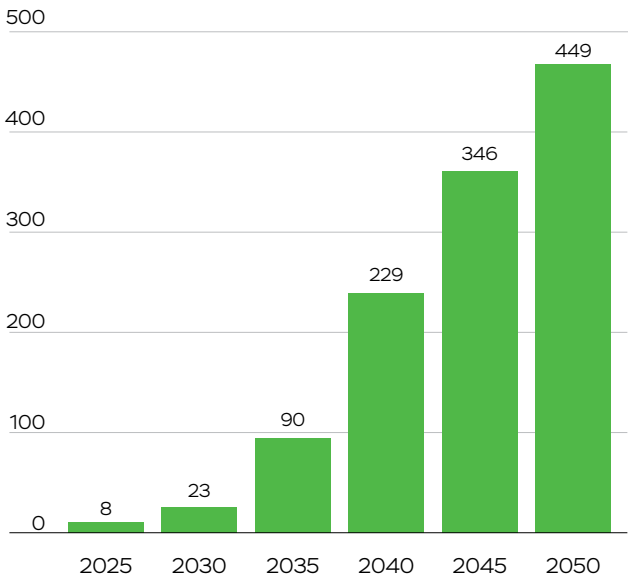
Source: IATA

LIFECYCLE GHG EMISSIONS OF SAF



Source: IATA

EXPECTED SAF REQUIRED FOR NET ZERO BY 2050 (BILLION LITRES)



Source: IATA

cle. Biomass may include algae, crop residues, animal waste, forestry residues and sludge. However, production often requires advanced technologies and complex processes, such as thermochemical or biochemical conversion, that are rather expensive and energy-intensive.

TURNING POWER TO LIQUID. While both first and second generation biofuels offer significant GHG savings, it is very unlikely that they will ever be available at the scale needed to decarbonise global commercial aviation. Hence intensive research is in progress towards e-fuels, also known as electrofuels. E-fuels are synthetic fuels that are prepared from renewable energy sources and captured CO_2. They are made using a process called "power to liquid" (PtL) that produces liquid hydrocarbons synthetically. Renewable electricity is the key energy source, and water and CO_2 are the main raw materials used in PtL production, which consists of three main steps:

- Renewable energy powers electrolysers to produce green hydrogen.
- Climate-neutral CO_2 – captured by, for example, Direct Air Carbon Capture (DACC) – is converted into carbon feedstock.
- Carbon feedstocks are synthesised with green hydrogen – via processes such as Fischer-Tropsch – to generate liquid hydrocarbons. These are then converted to produce a synthetic equivalent to kerosene.

Capturing and storing CO_2 are central to the production of PtL. In fact, capturing CO_2 released during combustion and combining it with hydrogen forms a "virtuous circle" in that the CO_2 that is emitted by burning is itself reused to create more fuel.

PtL is a potential solution to reduce GHG emissions from the transport sector, especially for long-distance freight, marine, and air transport. However, it requires a lot of energy to produce and incurs high production costs, which is a major drawback. According to various studies, the production cost per litre of PtL kerosene can vary widely, ranging from three to six times that of traditional fossil fuels.

TESTING TIMES. Aircraft and engine manufacturers are also striving to advance their SAF initiatives. Currently SAF approved for use is a synthetic component blended with petroleum-based Jet A or Jet A-1 fuel up to 50 per cent. However, an international task force led by one of GE Aerospace's experts is developing standardised industry specifications supporting the use of 100 per cent drop-in SAF, which does not require blending with traditional jet fuel. Some airlines have already conducted long-distance flights with one engine powered entirely by SAF.

GE and its joint venture partners are leading efforts to conduct engine testing and demonstrations which can provide valuable data to support development of 100 per cent SAF standards. In December 2023, GE Aerospace reached a significant milestone in successfully testing ten different aeroengine models using 100 per cent SAF since 2016. The engines include a mix of propulsion systems used in commercial, military, business, and general aviation aircraft. The ongoing research aims to understand the impact of 100 per cent SAF on engine performance, emissions, and contrails. Suitable standards are also required to be formulated to allow any type of SAF to be freely used on any commercial aircraft anywhere in the world – much like normal jet fuel at present.

On November 28, 2023, Virgin Atlantic became the first commercial airline to complete a transatlantic flight using 100 per cent SAF. The Boeing 787 took off from London and landed safely in New York City, thus demonstrating that SAF is a viable alternative to traditional jet fuel and is compatible with current engines, airframes, and fuel infrastructure. However, as a matter of abundant caution for passenger-carrying planes, both Boeing and Airbus are committed to building aircraft specifically designed to run on 100 per cent SAF by 2030.

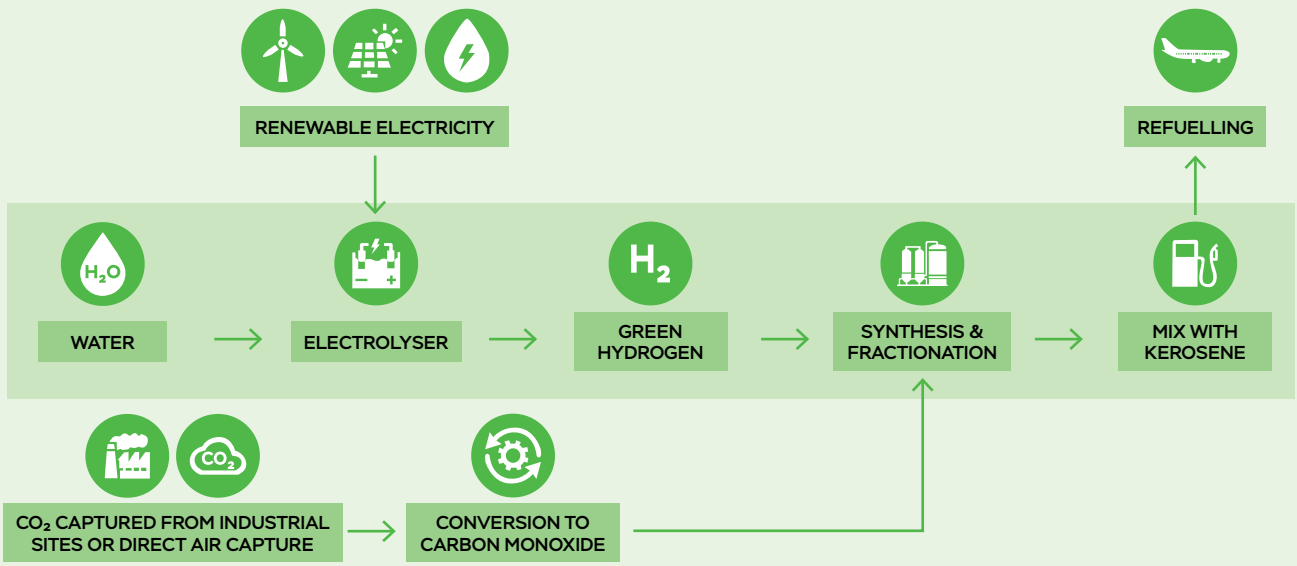
PRODUCTION PAINS. In 2023, SAF constituted just 0.2 per cent of global jet fuel volumes, yet the aviation industry views SAF as the most feasible near-term option. Although electric motors and hydrogen burning turbines show immense promise, they are probably decades away from large scale commercialisation. Unlike SAF, they will also require transformational changes in aircraft, engines, airports and various supporting facilities.

IATA predicts that the airline industry will require almost 450 billion litres of SAF by 2050. Against this only 300 million litres were produced in 2022, while the estimate for 2023 is 600 million litres. Production is projected to triple to 1.875 billion litres in 2024 but even at such dramatic rates of growth there is likely to be a huge shortfall in meeting the 2050 requirement.

The Indian government needs to establish a proper roadmap and economic incentives for SAF production so as to cash in on the golden opportunity to produce and even export SAF

POWER-TO-LIQUIDS FOR AVIATION

PtL is a type of sustainable aviation fuel (SAF) that is composed of synthetically produced liquid hydrocarbons



Source: Airbus

IATA believes that 30 billion litres of SAF is a tipping point for SAF production and utilisation for commercial aviation. However, SAF production costs currently exceed those of traditional jet fuel by a large amount, driven by feedstock shortages and early-stage market factors. There's simply not enough SAF being produced, and in order to reach production at scale, significantly higher investment is essential.

INDIA'S INITIATIVES. Around 145 countries have announced – or are considering – net zero targets. If all these pious intentions translate into real action they will cover about 90 per cent of global carbon emissions. India has pledged to reach net zero by 2070. It has also made a small start towards the use of SAF. In November 2023, the National Biofuels Coordination Committee (NBCC), chaired by Union Petroleum Minister Hardeep Singh Puri, set the indicative SAF blending percentage at 1 per cent for 2027 and 2 per cent for 2028. These will initially apply only to international flights.

The nation's inaugural commercial-scale SAF plant at Panipat, built by state-owned Indian Oil Corporation (IOC) should be up and running by 2026. Mangalore Refinery and Petrochemicals Limited (MRPL), a subsidiary of ONGC, also has plans to commence SAF production. Initially it will be a small 20-kilolitre-per-day plant to demonstrate indigenously-developed technology. Subsequently, it will need about two-and-a-half years to set up the main plant at an estimated cost of around ₹450 crore. These and other industry initiatives are essential to support the government's one per cent SAF blending target. The government needs to establish a proper roadmap and economic incentives for SAF production so as to cash in on the golden opportunity to produce and even export SAF. This would also help India meet its commitment of net zero carbon emissions by 2070.

In December 2023, GE Aerospace reached a significant milestone in successfully testing ten different aeroengine models using 100 per cent SAF since 2016

BOOSTING PRODUCTION IS THE KEY. SAF is essentially about biomass and waste – including waste CO_2 – being turned into "green gold", or jet fuel, to slash emissions. However, tight supply of raw materials and high production costs make large-scale SAF production challenging. IATA's Director General, Willie Walsh, says, "Despite unequivocal demand signals, the SAF production market is not developing fast enough. We need SAF everywhere in the world, and to that end, the right supportive policies – policies that can stimulate production, promote competition, foster innovation, and attract financing – must be put in place today."

Without the right policies, there is a significant risk that global SAF production will fall well short of the requirement. That is one reason why environmental activists are openly sceptical about what SAF can achieve, terming the whole exercise as mere "greenwash". They advocate urgently reducing flights wherever possible as the only way to genuinely reduce aviation's climate change impact.

However, that is clearly not something the aviation industry would like. Commercial aviation has experienced and surmounted numerous challenges during its long history. And the industry views the transition to large-scale use of SAF as just another challenge to be robustly faced. SP

Prime Minister Modi at the foundation laying ceremony of C295 Aircraft Manufacturing Facility, in Vadodara, Gujarat

QUEST FOR ATMANIRBHARTA IN COMMERCIAL AVIATION

India must secure self-reliance in the aviation sector, given its imminent position as the world's third-largest air passenger market by 2024, and its substantial contribution to the national GDP.

BY **ANIL CHOPRA**

WHILE LAYING THE FOUNDATION stone of Tata-Airbus C295 transport aircraft manufacturing facility - the country's first in the private sector - in Vadodara, Gujarat on October 30, 2022, Prime Minister Narendra Modi said that India will soon manufacture large passenger aircraft, and they would also be marketed across the globe. The country's aerospace industry is set for a paradigm shift, he added.

The approach could be two fold. Firstly, to convince major foreign civilian aircraft makers like Boeing and Airbus to set up a final assembly line in India. Secondly, to begin the process of designing an Indian airliner from drawing board stage. The two routes should move concurrently. It makes sense considering the huge demand.

PHOTOGRAPH: PIB

GLOBAL CIVIL AVIATION PREDICTIONS. In its 2023 report, Airbus' Global Market Forecast (GMF) for the 2023-2042, predicts demand for passenger traffic will grow annually by 3.6 per cent CAGR (Compound Annual Growth Rate) over the next 20 years. As of June 2022, the total worldwide commercial aircraft fleet size was 28,674 aircraft (23,513 active and 5,161 grounded). Airbus has forecast a demand for 40,850 new passenger and freighter aircraft deliveries over the next 20 years, of which 32,630 will be typically single-aisle and 8,220 wide-body. A June 2023 Boeing forecast expects airlines will need to buy 42,595 jets from now until 2042, with 32,420 being single-aisle jets, 7,440 wide-body planes, 1,810 regional jets and 925 freighters.

A Bain and Company report forecasts that by 2030, Europe–North America travel could increase about 17 per cent from its

2019 demand, while Asia intra-regional travel could jump 61 per cent. Asia maintains a much stronger outlook for long-term disposable income growth, and low-cost carriers also continue to accelerate growth.

HUGE INDIAN CIVIL AVIATION MARKET. India is not only the fastest growing major economy, but also the fastest growing civil aviation market, and its domestic air passenger traffic touched a new high of 4,63,417 people on November 23, 2023. Already the third-largest domestic aviation market in the world, it is expected to overtake the UK to become the third-largest global air passenger market by 2024. Indian aviation contributes five per cent of the national GDP. It also plays a crucial role in promoting tourism, and cargo movement. India will have 220 airports with scheduled flights by 2025 compared to 140 in 2022. Indian airports handled 188 million passengers in 2022. The current airliner fleet of around 750 aircraft will more than double in five years. 100 per cent FDI is cleared in most sectors of civil aviation.

"Positive attitude, progressive policies, and deep trust among passengers are taking it to new heights with every flight, everyday" tweeted India's Civil Aviation Ministry. The two largest Indian airlines IndiGo and Air India have announced plans to acquire over 500 aircraft each in the coming decade.

As per DGCA, the passenger count of India's domestic airlines reached 1,254.98 lakhs in the period January-October 2023 against 988.31 lakhs during the corresponding period of previous year thereby registering annual growth of 26.98 per cent. The increase in the volume of passengers reflects on India's rising economy, income levels, and demonstrates the strength and durability of India's aviation sector, and the rising demand for air transportation.

INDIA'S TRANSPORT AIRCRAFT BUILDING ECOSYSTEM. Hindustan Aeronautics Ltd (HAL) has been producing the HS-748 'Avro' and Dornier Do-228 aircraft in India under licensed production. HAL has also been making civil certified Do-228 aircraft. Also, National Aeronautics Laboratory has designed and test flown the 'Saras' small transport aircraft which will be used as 14-seat light transport aircraft. Saras Mk2 will be 19 seater. HAL will manufacture it at its Kanpur facility, and Defence Research and Development Organisation (DRDO) will be developing an indigenous turboprop engine for the aircraft. This is work still in progress.

The Tata group companies are already building aerostructures for many helicopters and also C-130J transport aircraft for global customers. Tata group is working with GE to manufacture CFM International LEAP engine components in India. Many Indian MSMEs and startups are in aircraft systems production.

Meanwhile a Tata consortium will be building 40 Airbus C295 MW aircraft and significant numbers of its sub-systems in India at a plant in Baroda, Gujarat. The first 'Made in India' aircraft will roll out of the new facility in September 2026. Before the completion of deliveries in 2031, a D-level MRO (maintenance, repair, and operations) facility will be set up in India. This facility will act as a regional MRO hub for various variants of C295 aircraft. The indigenous content in these planes will be the highest ever in India, with 96 per cent of the work that Airbus does in Spain gradually being done at the new facility in India. More than 125 domestic MSME suppliers spread across different states. This project should also help India in pushing its commuter aircraft.

"India will soon manufacture large passenger aircraft, marketed globally—a paradigm shift in the country's aerospace industry." —Prime Minister Narendra Modi

JUSTIFICATION FOR BUILD IN INDIA. India will buy more than 90 per cent of all airplanes delivered to South Asia in the next 20 years. India's passenger and cargo sector requirement is close to 120 aircraft a year, implying around 10 aircraft a month. That is a significant market for any airliner manufacturer. Indian government has been incentivising 'Make in India' in aviation. India has the skilled manpower, and favourable demographics for many more decades. The country has large number of medium and small manufacturers who are already supplying globally certified systems to international customers. Country has huge land banks near airports that can be allotted to major manufacturers.

China's dictatorial aggressive approach and unilateral actions in South China Sea has antagonised the world. Also, its supply chain - approach has forced responsible free world nations to decouple from it. China's population is ageing due one child policy, and also economic growth is slowing down. The general trend among global manufacturers including Apple, Samsung and Nokia, is to move manufacturing in India. While China will continue to require many airliners, Beijing's home-grown civil aircraft have already begun to compete with Boeing and Airbus in that market. Major manufacturers are pulling out and setting up shop elsewhere. India is the natural alternative choice.

The Indian aviation market will need an estimated 2,200 new aircraft between 2022 and 2040, a three-fold jump from the country's commercial fleet at present. India's economy is bullish. Country is a well-established mature democracy, and no political shocks are likely. Manufacturing in India could be nearly 25 per cent cheaper, and it could become a global hub. It could service the growing markets in West Asia.

The massive 470-aircraft Air India order includes 250 Airbus passenger jets in additional to 190 737 MAX aircraft, 20 of Boeing's 787s, and 10 of its 777Xs. IndiGo airline has placed a record order for 500 A320 family aircraft. Both, Boeing and Airbus, are under pressure to set up manufacturing in India. They both will look for first mover advantage. Civil aviation would be an important element of India's dream of becoming the "new factory of the world". How early it will happen, only time will tell.

CONDUCIVE BUSINESS FRIENDLY ENVIRONMENT. India has been steadily moving up in "ease-of-doing-business" rankings over the years. The economic survey 2022-23 indicated that India reduced over 39,000 compliances for ease of doing business. Yet more is being done. The rail, road, and port infrastructure is coming up at high pace. Red-tape has reduced considerably. 100 per cent FDI is already cleared in most sectors of civil aviation. Skilled labour is getting in place. India is already a global hub for automobile and mobile phone sectors and manufacturing quality is thus not an issue. Aviation rated production quality is now of global standard. Boeing already has nearly 5,000 employees and 300 suppliers in India. They make B737 aircraft

fins at their Hyderabad facility. Airbus also has nearly 50 years presence in India, and same will increase many fold with the C295 manufacture.

An important condition for foreign OEMs to manufacture in India is to have an appropriate local partner. It will greatly support regulatory clearances and project management. Major aviation giants like Lockheed Martin and Boeing have followed that strategy. India will thus be a great location for any company's global manufacturing map and its path to profitability.

2018 TASK FORCE. A Feasibility Study had been carried out by CSIR - National Aerospace Laboratories (CSIR-NAL), Bengaluru for National Civil Aircraft Development (NCAD) programme. The programme for development of a 90 seater aircraft will have two phases namely, design & development phase and manufacturing phase. The total estimated budgetary requirements of the NCAD programme is ₹7,555 crore, out of which ₹4,355 crore is for design & development phase and ₹3,200 crore for series production phase. In 2018, a taskforce was set up by government of India for suggesting a roadmap to build indigenous planes. It was to suggest setting up a special purpose vehicle (SPV) for the ₹10,000-crore project. The 106 members included those from the aircraft industry. This has been done in pursuance of the National Civil Aircraft Development (NCAD) programme and for promotion of India as an important investment destination and global hub for the manufacture, design and innovation under the 'Make in India' initiative. The development of the Regional Transport Aircraft was to be considered.

REGIONAL JET PLAYERS. While Boeing and Airbus have dominated the large commercial aircraft market, there are other players in regional jets which are smaller aircraft, fly shorter ranges, and carry fewer passengers. Bombardier of Canada and Embraer of Brazil are the historical leaders in the regional jet market. Commercial markets also include turboprops. There are other players in the business jet market such as Beechcraft, Cessna, Dassault, Gulfstream, etc. Around 200 regional jets are built by various manufacturers every year. The US and Europe dominate the sector. The Comac ARJ21 is a 78–90 seat regional jet manufactured by the Chinese state-owned aerospace company. 114 had been built by July 2023. The HAL/NAL Indian Regional Jet (IRJ) is planned asa 90 seater with targeted first flight around 2026. But the work is still in slow progress.

ATR VS DORNIER DO-228. The price of Do-228 is around 60 crore as compared to an estimated price of over 160 crore for ATR-72. The operational cost of ATRs is over 2 lakh per flying hour in comparison to Do-228's 85,000 per hour. On many short haul regional routes it is difficult to fill up 70 seats of the ATR 72-600. The ATR needs a minimum 70 per cent occupancy to break even. Do-228, which is made in India turboprop with some imported components and imported engine (Honeywell), has a seating capacity of 19. The Dornier 228 aircraft requires runway length of 2,100 feet for take-off and 1,800 feet for landing. The aircraft thus has higher usability.

PRIVATE SECTOR IN AEROSPACE. Tata Advance Systems Ltd (TASL) is already in manufacture of aircraft (C295), aerostructures and many sub-systems. Mahindra Aerospace acquired Australia's Gipps Aero and Aerostaff, and became first Indian company to go into full aircraft production, albeit a small one and that too outside India. The company has developed a major facility outside Bengaluru to produce airframe parts and assemblies within the country. The company is working with Airbus Helicopters for a joint venture to produce helicopters in India. Bharat Forge is forging aircraft parts for foreign OEMs. Reliance has the 400-acre Dhirubhai Ambani aerospace park at Nagpur for the manufacture of aerospace components. Adani Aerospace already makes UAVs in India. They are also in aircraft services and MRO.

(Left-Right) Given the massive aircraft orders by Air India and IndiGo, both Boeing and Airbus are under pressure to set up manufacturing in India

THE ROUTE TO THE INDIAN AIRLINER. India has to harness the huge airliner and aero-engine demand to get OEMs to manufacture in India in partnership with local partners. First step is to get ATR, Airbus or Boeing to set a production line in India. Similarly India must also get some major civil airliner aero-engine manufacturer to set up a production line in India with a local partner. The next logical step would be to build our own short haul ATR-42 and 72 class aircraft, and later also single-aisle aircraft of Boeing 737 and Airbus A320 class.

The GE-F414 aero-engine will be made in India by General Electric in a joint venture with Hindustan Aeronautics Ltd (HAL), with some level of technology transfer. For civil aero-engine we must insist on a joint venture with significant technology transfer by leveraging high numbers and growing market.

India's drone and UAV industry must start looking at manned and unmanned urban air mobility. With the drones and

PHOTOGRAPHS: Airbus

unmanned systems eco system getting in place in India, this is one area India must ride the bus at an early stage.

TAPPING INTO THE HUGE MRO MARKET. India has a huge MRO market for civil and military aircraft, and engines. A 2023 CRISIL report states that India's MRO sector still faces obstacles such as difficulty obtaining credit, inadequate infrastructure, high taxes, licensing and certification issues, and high rental costs. But Indian government has introduced several policies to support making the country a global MRO hub. These includes reducing GST on MRO services from 18 per cent to 5 per cent, land lease policies for longer durations to lower rental costs, and discontinuing the 13 per cent government charged royalty on revenue. These should support reduction of costs by 10-20 per cent.

Setting up an MRO is highly capital intensive with a long break-even time. It requires continuously reskilled manpower and repeat investments in tooling, and certification from safety regulators such as the FAA and EASA, and global OEMs such as Airbus, Boeing, and many others.

Delhi and Bengaluru airports have established dedicated MRO facilities and these are being extended. A huge MRO hub will come up at the upcoming Noida International Airport, Jewar, Uttar Pradesh. More airports like Belegavi, Bhopal, and Tirupati will have MRO facilities. India's Directorate General of Civil Aviation (DGCA) would have to stipulate international standards on the lines of those by FAA and EASA for international recognition.

As per Indian government's top think-tank Niti Ayog report of October 2022, the Indian MRO industry was $1.7 billion in 2021. The global MRO market was worth $78.6 billion in 2022. The Indian market is expected to be $4.0 billion by 2031, growing at 8.9 per cent CAGR, faster than any other country. NITI Aayog has recommended incremental approach, by first setting up joint-ventures in India with global players, and gradually ascending the work-value chain. Ultimate India must aspire to be an international class MRO hub like in Singapore. A surge in local MRO facilities will be good for airlines operations, safety and costs.

CURRENT MRO PLAYERS. The current major Indian MRO players are, AIESL (Air India Engineering Services Ltd), Air Works India, and GMR Aero Technic Limited, among a few others. The airlines growth makes a great case for strategic investors, Original Equipment Manufacturers (OEMs) and global MRO players. Policy initiatives such as the MRO Policy 2021, National Civil Aviation Policy 2016, rationalisation of GST, are great incentive. Hindustan Aeronautics Limited (HAL) and Airbus have formalised an agreement to establish state-of-the-art Maintenance, Repair, and Overhaul (MRO) facilities for the A320 family of aircraft.

THE WAY AHEAD. Despite being the fastest growing economy and civil aviation market, India has not yet leveraged large airliner orders to get aircraft and engine manufacturers to set up shop in India. Nor has India tapped into the huge MRO market. The country does have manufacturing and assembly skills, but lacks original design work. The global and domestic narrow-body airliner market is huge. India must insist Boeing and Airbus to set up assembly lines in India and give component orders to local manufacturers. Large groups like Tata with aerostructure manufacturing experience, and simultaneously operating a huge airline, can bag more manufacturing orders. In the civil aviation sector, HAL is already manufacturing aircraft parts for Boeing and Airbus, and manufacturing Dornier 228 for RUAG of Switzerland. But so much more needs to be done.

India must set up an independent authority on the lines of the Aeronautical Development Agency (ADA) as envisaged under National Civil Aircraft Development (NCAD) programme to push civil aviation aircraft development. It must function under PMO as it would involve inter-ministerial support. It may subsume the transport aircraft building facilities of HAL and NAL. The agency can also be tasked to work on the MTA for IAF. The agency must also drive building MRO facilities. We may seek foreign consultancy for aircraft design. India must insist on foreign OEM to set up engine manufacturing through a joint-venture route. We must do all aircraft interiors work in India to begin with. Why cannot India make aircraft seats and other interiors in India itself? Avionics is another area where India is way behind and that requires task-force-like action.

West is moving out of China. Europe has a high cost of production. India is the next best destination. India also has large land banks near airports, especially the newer Greenfield ones. Government policies are becoming more attractive for promoting the manufacture and shifting MRO to India. Finally, India has to invest much more in R&D. Developing your own designs and having your own patents is important. India is a rising star, the time to act is now, lest we lose another golden opportunity. It has to be a whole-of-nation approach. SP

Made in India: (Left) Light Transport Aircraft SARAS Mk 2 by NAL; (Right) Dornier 228 by HAL.

PHOTOGRAPHS: NAL, SP Guide Pubns

ATR 72-600 is leading the way in Regional Transportation

CHAMPION OF REGIONAL TRAVEL

The future of regional travel is being redefined by ATR's revolutionary and innovative turboprops

BY **ROHIT GOEL**

ESTABLISHED IN 1981 AS a collaborative endeavour between Airbus and Leonardo, Avions de transport régional (ATR) has emerged as a pivotal player in the production of turboprop regional aircraft. Addressing the growing demand for efficient and cost-effective short-haul flights connecting regional destinations, ATR has become synonymous with fuel efficiency and sustainability within the realm of regional aviation, solidifying its unique position in the aerospace industry.

Guided by a vision to create fuel-efficient and versatile aircraft tailored for short-haul routes, ATR translated this vision into reality with the introduction of the ATR 42 – the company's inaugural turboprop aircraft. Rapidly gaining acclaim for its exceptional performance on challenging runways and in extreme temperatures, the ATR 42 marked the inception of a family of turboprop aircraft that excelled in connecting communities and delivering unparalleled operating economics.

Above and beyond the cutting-edge technology and operational versatility exhibited by the ATR 42 and 72 series, ATR's commitment extends to connecting communities and minimizing environmental impact. The collaboration between Airbus and Leonardo has not only propelled ATR to the forefront of global aviation but has also positioned the company as a cornerstone dedicated to ushering regional connectivity into a sustainable future.

PHOTOGRAPHS: ATR

Other members of the ATR family:
(Clockwise from Top Left) ATR 42-600; ATR 42-600S; ATR-72-600-HighLine; ATR 72-600F Freighter

ATR's efficient and economical turboprops have transformed the landscape of regional air travel, soaring above the competition. As the world increasingly prioritses eco-conscious travel, ATR stands poised to lead the way, leaving an indelible mark on the skies for generations to come. With an impressive range of regional turboprop aircraft serving the regional aviation market, ATR has not only carved a niche for itself but has also positioned itself as a driving force in shaping the future of sustainable air travel.

UNVEILING THE ATR 42-600 AND ITS STOL VARIANT, THE ATR 42-600S. Embark on a journey of unparalleled efficiency and comfort as we explore the legacy of the ATR 42-600, an aircraft that seamlessly blends refined interiors with cutting-edge technology. A spacious cabin, bathed in natural light, invites 30-50 passengers to experience comfort like never before, with ample legroom and generous overhead storage. Beyond the welcoming interior, the ATR 42-600 stands out as a meticulously crafted regional aircraft, where twin turboprop engines harmonise to propel it across distances while exhibiting remarkable fuel efficiency – earning it the admiration of airlines worldwide.

ATR turboprop aircraft are known for their fuel efficiency and sustainability, solidifying their unique position in the regional aviation industry

But the allure of the ATR 42-600 extends beyond its welcoming interior. Designed to tackle diverse terrains, from scorching deserts to icy airstrips, this aircraft fearlessly navigates gravel runways, challenging approaches, and hot-and-high environments. It seamlessly connects far-flung communities that were once off the beaten path, embodying a legacy of versatility and resilience.

Introducing the ATR 42-600S – the younger sibling that takes short-haul flights to new heights. This Short Take-Off and Landing (STOL) variant redefines regional connectivity, allowing take-offs from runways as short as 800 meters and unlocking access to over 1,000 previously inaccessible airports. The ATR 42-600S achieves this feat through its robust PW127XT engines, enlarged rudder, and innovative ground spoilers, working in perfect harmony to defy limitations and reach remote corners of the world.

This breakthrough in aviation technology not only expands

the horizons of air travel but also holds the key to economic development, tourism growth, and fostering closer ties between communities. Join us as we delve into the transformative capabilities of the ATR 42-600 and its groundbreaking variant, the ATR 42-600S, as they elevate regional connectivity to unprecedented levels.

THE ATR 72-600'S UNPARALLELED FUSION OF ELEGANCE AND EFFICIENCY. In the dynamic landscape of regional aviation, the ATR 72-600 stands out as the epitome of sophistication and efficiency. With a seating capacity of up to 78 passengers, this market-leading regional aircraft has garnered acclaim from both the airline and financing sectors for its exceptional fuel efficiency and minimal CO_2 emissions. Beyond its economic prowess, the ATR 72-600 demonstrates a commitment to accessibility by effortlessly navigating challenging airfield profiles, including extreme temperatures, high altitudes, short, narrow, and unpaved runways, as well as steep approaches. This prowess ensures vital connectivity to even the most remote communities.

At the core of the ATR 72-600's success is its integration of state-of-the-art technology, a spacious cabin, and a commitment to responsible aviation practices. This aircraft seamlessly links people and businesses, embodying a modern, reliable, and eco-conscious approach to regional connectivity. With its lighter structure, optimised speed, and an engine tailored for short sectors, the ATR 72-600 stands as the paragon of fuel efficiency in the regional aircraft domain. ATR's fuel burn advantage not only reduces costs but also minimises emissions, making it the optimal choice for regional markets. In fact, the ATR 72-600 sets the benchmark, with operating costs on competing regional jets being at least 45 per cent higher.

Beyond its efficiency, the ATR 72-600 redefines in-flight comfort, ensuring every passenger experiences ample legroom, cozy seating, and generous overhead bins for luggage storage. Whether embarking on a business trip or leisurely journey, passengers can rest assured that ATR aircraft deliver an unparalleled level of comfort throughout the entire expedition. Depending on the chosen configuration, the ATR 72-600 accommodates up to 78 passengers, further solidifying its position as the go-to-choice for regional air travel.

ELEVATING FREIGHT EFFICIENCY WITH THE ATR 72-600F. In the dynamic landscape of regional freight aviation, ATR stands as a seasoned player, boasting extensive expertise in the market. With approximately 130 converted ATR freighter aircraft currently in operation, constituting a substantial one-third share of the global regional freighter fleet, ATR is at the forefront of delivering efficient and reliable solutions. The newly introduced ATR 72-600F is a testament to the amalgamation of this wealth of experience, tailored to meet the evolving demands of the industry.

The ATR 42-600 and 72-600 series are paragons of both sophistication and operational efficiency, featuring advanced avionics, ergonomic cockpits, and adaptable designs

In the face of a shifting market paradigm, fuelled by the rapid expansion of e-commerce, the ATR 72-600F emerges as the ideal solution for connecting communities and economies worldwide. ATR 72-600F assumes a pivotal role in fortifying global supply chains, ensuring the seamless and sustainable transport of essential goods to their destinations.

Operators now have the opportunity to leverage the distinctive advantages embedded in the ATR 72-600F's impressive 75m^3 freight capacity. The purpose-built freighter's fuselage embodies a sleek and cargo-optimised design, tailored to meet the specific needs of freight transport. Featuring a large cargo door, this aircraft facilitates the efficient loading of up to nine tonnes of payload. Moreover, it offers the flexibility of transporting either bulk cargo or, in Unit Load Device (ULD) mode, accommodating five 88" x 108" pallets or up to seven LD3 containers.

Pilots operating the ATR 72-600F can harness the cutting-edge capabilities of the latest upgradable Standard 3 avionics suite. This innovation empowers the introduction of continuous cockpit advancements, enhancing overall operational efficiency. As the aviation landscape continues to evolve, the ATR 72-600F remains at the forefront, embodying a perfect synergy of efficiency and muscle to meet the demands of a rapidly changing world.

UNVEILING THE ATR HIGHLINE. Embarking on a transformative journey within the aviation industry, the ATR HighLine emerges as a paragon of opulence, redefining the standards for high-end cabin interiors dedicated to discerning air carriers. Tailored for those who seek an unparalleled experience for their guests, this collection of configurations is a testament to ATR's commitment to providing the best in style and the ultimate in comfort across their family of advanced aircraft.

At the core of the ATR HighLine is a commitment to creating a superlative onboard atmosphere while employing cutting-edge, low-emission technology to fly responsibly. This strategic disruption within the regional travel industry underscores the collection's pioneering role from within, setting a new benchmark for excellence.

Comprising five distinct cabin configurations, the ATR HighLine is the result of an innovative approach, integrating in-house ATR developments and collaborative designs from luxury partners. These interiors transcend traditional boundaries, offering operators the flexibility to tailor cabins to reflect personal lifestyles, meet operational needs, or cater to high-end destinations that demand a luxurious experience.

The ATR HighLine stands as a beacon of limitless style options, exceptional quality, and exclusivity while upholding a responsible approach. This unique combination positions these cabins as the perfect choice for conscientious travellers journeying to remote destinations, where sophistication and discretion are paramount.

Beyond the conventional confines of regional travel, the ATR HighLine collection provides spacious experiences that rival the largest business jets globally, surpassing the business turboprop market. With additional cabin width and length, a full standing aisle, and a completely flat floor, these cabins distinguish themselves from 30 and 50-seat commercial regional jets. Boasting twice the cabin volume, the ATR HighLine offers unrivalled interior design options, setting a standard impossible to achieve on any other turboprop or regional jet aircraft, whether for commercial or business purposes.

A CELEBRATION OF PROGRESS AND INNOVATION. The ATR 42 and ATR 72 series have the same fuselage cross section, use the same systems, share the same engines and

ATR SPECIFICATIONS COMPARISON

	ATR 42-600	ATR 42-600S (STOL)	ATR 72-600	ATR 72-600F (Freighter)
PERFORMANCE				
Take-off distance (MTOW, ISA SL)	1,107 m	800 m* *70% load factor, ISA, SLA	1,315 m	1,315 m
Landing distance (MLW, SL)	966 m	810 m	915 m	915 m
Range Max Pax	726NM/1,345 km	680NM/1,259km	740 NM/1,370 km	1,030NM/1,908 km Range based on max volumetric payload
WEIGHT & PAYLOAD				
Maximum Take-off Weight	18,600 kg	18,600 kg	23,000 kg	23,000 kg
Maximum Landing Weight	18,300 kg	18,300 kg	22,350 kg	22,350 kg
Maximum Zero Fuel Weight	17,000 kg	17,000 kg	21,000 kg	21,000 kg
Maximum Payload	5,250 kg	5,150 kg	7,400 kg	9,200 kg
Maximum Fuel Load	4,500 kg	4,500 kg	5,000 kg	5,000 kg
DIMENSIONS				
Overall Length	22.67 m	22.67 m	27.17 m	27.17 m
Wingspan	24.57 m	24.57 m	27.05 m	27.05 m

Source: www.atr-aircraft.com

propellers, as well as the same cockpit, allowing for common type rating or cross crew qualification (CCQ). This results in major cost savings for operators in terms of flight crew training and maintenance. Some 90 per cent of the spare parts are common to both models.

The ATR-600 series' full glass cockpit offers to pilots a simple working environment. It has raised the bar in human-machine interfaces offering a high level of comfort and demonstrable efficiency gains. Navigation, communication and surveillance functions are integrated into a modular avionics architecture. This state-of-the-art philosophy is open and evolutionary to allow new software and hardware functionalities to be inserted in the future independently: continuous development is the ATR DNA.

ATR 42-600 and 72-600 stand as paragons of both sophistication and operational efficiency. These aircraft seamlessly meld elegance with functionality, asserting themselves as unrivalled leaders in the field. Their technological prowess, economic advantages, and unwavering commitment to passenger comfort collectively establish a new benchmark for regional aircraft, cementing their position as the preferred choice for both airlines and passengers.

The ATR 42-600 and 72-600 exemplify the transformative force of innovation in aviation. Infused with cutting-edge technologies, these aircraft showcase advanced avionics, ergonomic cockpits, fuel-efficient engines, and adaptable designs. This steadfast dedication to progress manifests in exceptional performance, unparalleled versatility, and steadfast reliability. Beyond mere transportation, these aircraft symbolise connectivity and catalyse economic growth, facilitating the prosperity of businesses and communities alike. In essence, the ATR 42-600 and 72-600 redefine the landscape of regional aviation, setting a standard that resonates across the industry.

ATR's turboprops connect far-flung communities and remote destinations, often inaccessible to larger jets, fostering economic development and tourism growth

THE FUTURE SOARS WITH ATR. Soaring above the competition, ATR reigns supreme in the realm of regional aviation. Its iconic ATR 42 and 72 series, honed through years of innovation, embody a steadfast dedication to connecting communities, minimising fuel consumption, and adapting to diverse operational needs.As the world embraces sustainable practices and seeks efficient logistics solutions, the ATR 72-600 and 72-600F stand poised to dominate the regional aviation landscape. These remarkable machines are not just aircraft; they are instruments of progress, connectivity, and a sustainable future for both passenger and cargo transportation.

ATR's ascent to prominence paints it as a cornerstone of the global aviation landscape, forever etched in the annals of regional connectivity. But ATR's ambitions extend beyond mere dominance. Its unwavering commitment to efficiency, sustainability, and forging closer connections between communities positions it as a beacon of progress in the age of eco-conscious travel. With a fleet of versatile and dependable turboprop aircraft at its disposal, ATR is poised not only to maintain its market leadership but also to spearhead the evolution of regional aviation towards a greener, more sustainable future. As the world takes flight towards a cleaner tomorrow, ATR stands ready to chart the course, propelling regional aviation to new heights of efficiency and environmental responsibility. SP

The adoption of Augmented Reality is gaining momentum in Maintenance, Repair, and Overhaul (MRO) training

MRO INNOVATIONS

The onset of the digital revolution in aviation is transforming the MRO sector with advanced technologies

BY **SUKHCHAIN SINGH**

DEMAND FOR MAINTENANCE, REPAIR and overhaul (MRO) services in India will bloom rapidly with domestic fleet expected to be more than 1,000 by 2027 from nearly 700 as of March 2023. In India, revenue of domestic MRO services providers is expected to triple to ₹5,500 - 6,000 crore by fiscal 2028 from about ₹1,800 crore currently, due to the strong growth in domestic civil aviation, government support, and ongoing MRO capex at airports.

OEM facilities across the globe that were temporarily closed during the pandemic had created shortage of parts and the scarcity of labour & raw materials resulting in slow post-pandemic recovery. This has resulted in Globalisation 2.0 which is More Dual Sourcing & Near-Shoring. The sales of OEM new freighter aircraft are bouncing back and demand for Passenger to Freighter (P2F) conversions are increasing. Engine and airframe MROs are also benefitting from additional MRO demand from the very old maintenance intensive aircraft due to their delayed retirement.

Technologies such as AI, Digital Twins, AR, Blockchain, Additive Manufacturing, Cloud Computing, real-time monitoring of aircraft condition and predictive maintenance, are the tools for service providers to manage with the reduced MRO budget of airlines. The increasing digitalisation of MRO to improve efficiency and reduce aircraft downtime is the key factor projected to propel the digital MRO market. However, such innovation would require changes not only in the industry culture but also from the safety regulators. According to a global newswire report the digital MRO market is projected to grow to $4.7 billion by 2030.

PHOTOGRAPH: Netherlands Aerospace Centre

ARTIFICIAL INTELLIGENCE. Aircraft technicians are scarce and with the increasing worldwide aircraft fleet and aging of technicians, the situation is likely to get worse. Royal Netherlands Aerospace Centre has developed a new tool to diagnose failures using Artificial Intelligence. It is AI software that looks at the failure modes of previous repairs and the aircraft usage to determine the relation between aircraft and system usage and the actual failure modes of repaired parts. It then uses these relationships to diagnose components or systems and identify the failure modes. To make the outcomes of failure diagnosis acceptable for maintenance personnel, the algorithms use explainable Artificial Intelligence. It not only identifies the failure modes, but also explains why a specific failure mode occurs. This means that it is a useful tool to determine the failure mode of parts removed in serviceable condition based on predictive indicators. It helps the shops to repair these parts and reduces no-fault-founds.

Airlines are increasingly connecting Artificial Intelligence to their MRO Strategies. Airlines based in the US, Europe and Asia have been adopting AI tools in the form of intelligent agents for data modelling and simulation, cognitive computing and predictive data analytics. A challenge exists for airline maintenance teams dealing with the large amount of data being produced by newer generation aircraft. Right now, Delta Air Lines is working on adopting artificial intelligence and machine learning into its aircraft maintenance strategy and has a five-year plan for officially adopting artificial intelligence into its predictive maintenance strategy. The use of artificial intelligence will be primarily to replace todays human tasks of ingesting, aggregating and analysing raw data transmitted by aircraft.

Airbus has emerged as an industry leader in introducing the use of artificial intelligence into airline maintenance operations. Airbus has established Skywise as its official predictive maintenance and advanced data analytics platform. It serves as a singular access point to data analytics that combine multiple sources into one secure cloud-based platform, including work orders, spares consumption, components data, aircraft/fleet configuration, onboard sensor data and flight schedules. The Airbus AI Gym, is pursuing to identify new and unexpected changes in the behaviour of monitored systems, as well as analyse suspicious behaviour for potential faults and failures more efficiently.

The digital MRO market is projected to reach $4.7 billion by 2030, driven by technologies such as AI, Digital Twins, AR, Blockchain, Additive Manufacturing, and Cloud Computing, offering tools for efficient management within reduced MRO budgets

DIGITAL TWINS. These are digital replicas of aircraft or aircraft components. Data sensors are embedded in well-thought-out locations to create this digital replica. These sensors work together to develop a real-time picture of aircraft performance. Aircraft companies use them to test new designs and predict how they will perform in the real world. Some of the biggest names in aviation already use this in MRO technology. Digital twins make it possible for aviation mechanics to monitor physical components while the aircraft is in the air. They can then plan maintenance resolving any potential issues that arise.

The future is digital – and this is especially true for the Maintenance, Repair and Overhaul of commercial aircraft. By 2025, more than 38,000 aircraft are forecasted to be in operation worldwide.

PHOTOGRAPH: Lufthansa Technik

The structural integrity of an aircraft is sustained by repeated and costly inspections. Application of a reliable Structural Health Monitoring (SHM) system formultiple load path structures therefore is an interesting application area to reduce the cost of ownership and to improve the system operational availability. This prevents costly periodic inspections and allows maintenance on demand after the system flags a partial failure. SHM technologies based on opticalfibre Bragg grating (FBG) sensors have been developed by Royal Netherlands Aerospace Centre for multiple load path structural components. An FBG is a small segment in an optical fibre that causes a shift in wavelength due to stretching or compressing of the fibre which can be correlated with a strain value. A valuable data input for digital twin.

5G-assisted virtual borescopics performed on an engine in an overhaul shop

SMART EQUIPMENT TECHNOLOGY. Prior to the introduction and widespread use of sensors and smart equipment, maintenance followed a predictable routine. Now, as sensors and Internet of Things (IoT) technology becomes more accessible and inexpensive, manufacturers are able to track equipment performance and maintenance needs, greatly reducing or eliminating the cost inefficiencies of outdated routines. Digitisation and smart technology produce vast amounts of data. This data is used to analyse supply chain performance, enabling manufacturers to provide more information to suppliers and develop true partnerships. This results in all across benefits from pricing to turnaround time. Digital MRO technology driven productivity should be the new normal in enhancing Digital MRO. The resultant dynamic manpower planning & scheduling with Real-time production control & critical path management will usher in efficiencies and improved TAT benefiting MRO cost optimisation.

DRONE USAGE. Drones have become increasingly common in the world of MRO. Technicians use them for various tasks during inspections and repairs. These machines are convenient for hard-to-reach spaces and areas that pose a high risk for human workers. The main difficulty of using drones stems from regulatory differences around the world. America currently has some of the strictest rules, making it difficult to enjoy the full scope of benefits drones bring to the inspection and MRO process. The Royal Netherlands Aerospace Centre has developed ARVI (Autonomous Robot for Visual Inspections), a clever robot system which is able to map inspection areas and identify defects such as dents, scratches, broken wires, arcing, corrosion, dirt, leakages and many more. It uses an autonomous vehicle to move the sensor system to the inspection areas. ARVI can navigate through the hangar and through aircraft just like human technicians avoiding collisions and positions the sensor system autonomously.

Artificial Intelligence is becoming integral to MRO strategies, addressing the scarcity of aircraft technicians by introducing diagnostic tools providing explainable AI for failure diagnosis

CLOUD-BASED MRO SOLUTIONS. Aviation MRO requires a significant investment in physical assets. Consequently, cloud computing removes the need for one set of digital physical assets: servers and IT space. The cloud manages maintenance schedules and keep track of aircraft components making it easier to share data across global MRO teams.

Customer Service Apps make information like price checking, availability of parts or repair services, placing orders, or obtaining the pending delivery status available. They also help conduct inventory cycle counts from time to time, ensuring an accurate and reliable inventory level. Work in Progress (WIP) accounting applications are boon for independent MROs since it is used for supporting accurate WIP accounting. Mechanics can now record the time they work on their tasks, and the firms can use it to optimise and find accurate costing, increasing their efficiency and profit.

BLOCKCHAIN. We've all heard of blockchain in a cryptocurrency-related context. However, this technology finds more use-cases, including "record-keeping." MRO teams generate a lot of data which needs to be kept secure and tamperproof. Blockchain technology assists in this process by allowing the data stored to be viewed only by those with a key. What makes this technology ideal is that it is cost-effective and requires minimal maintenance. MRO teams can keep track of mechanical parts, leases, inventory, digital twinning, supply chain, repairs, etc., through blockchain. Companies are yet to fully realise such tech-

PHOTOGRAPH: Lufthansa Technik

FOMAX Program extends the quantity of aircraft data available to reduce maintenance costs

nology for application in the aviation industry. This will gain traction in MRO as more use cases and regulatory trust is accepted by the environment.

AUGMENTED AND VIRTUAL REALITY (AR/VR). In today's world, augmented reality is experienced through glasses or eyewear, which can provide additional data to the viewer about what they're seeing. It is gaining popularity in the aviation industry, where MRO professionals are being trained with AR in aircraft maintenance. Augmented reality is used to visualise virtual 3D models of aeroplanes that MRO teams will be repairing, thus eliminating the need for expensive physical props. Additionally, they can all view the same model, which help facilitate teamwork. Augmented reality is being used in aviation training camps in Europe, and the technology may soon be rampant in India as well.

ADDITIVE MANUFACTURING. Additive manufacturing is already gaining popularity in the MRO sector. It uses computer-aided-design (CAD) software or 3D object scanners to direct hardware to deposit material, layer upon layer, in precise geometric shapes. Additive manufacturing enables the industry to print substantial, durable, and lightweight replacement parts that are quick and affordable and reduce the cost for maintenance providers. This is a disruptive technology which has the potential to change the way we look at MRO.

MRO & OEMS COOPERATION AND COMPETITION. The way in which MROs and OEMs have cooperated & competed has evolved over time. OEMs had largely left the MRO market to aftermarket independent and airline-affiliated MROs. During the last two decades, airframe, aircraft system and component OEMs have stepped in to compete with the independent and airline-affiliated MRO suppliers. Given the immense advantage OEMs have with intellectual property, design data and manuals, many of the larger MROs have chosen to partner with OEMs rather than competing. The trust generated through a strategic partnership with an OEM also leads to additional opportunities, thereby reflecting the two-way nature of OEM-MRO partnerships. The OEM-MRO industry is notorious for 'coopetition' – a combination of cooperation and competition. In the engine MRO space, there is more collaboration between MROs and OEMs. The component MRO space will continue to see significant consolidation and M&A activity.

BHARAT MRO. Global Maintenance Management developments in civil aviation will now create smarter organisations by providing managerial decision support tools and consultancy services for strategic challenges. Aviation Maintenance Technology innovations will allow cutting-edge knowledge and technologies to automate maintenance tasks and processes using robotics, prognostics and artificial intelligence. Similarly, Maintenance Engineering advances will drive process and product improvements, eg. with quantitative data analysis, creating smarter solutions by combining existing knowledge, techniques and methods. These will optimise maintenance operation, maintenance planning & resources, spares and personnel allocation. In the area of Maintenance Training, transformations will enhance training value using modern technology training devices employing virtual and augmented reality. Indian MRO therefore, must now seize the opportunity to leap frog in this sector and shun the traditional incremental approach. Capacity additions have already started. The Delhi and Bengaluru airports have set up dedicated MRO facilities for select private airlines. Plans are also in place to establish two MRO facilities near the new Jewar airport in Uttar Pradesh. Further, MRO facilities are planned to come up at the Belagavi (Karnataka), Bhopal (Madhya Pradesh) and Tirupati (Andhra Pradesh) airports. In order to attract new workforce in a market driven by skilled manpower shortages and the supply chain challenges the MRO industry will need to leverage training using virtual & augmented reality and built an MRO edifice on modern concepts. It must aggressively embrace digital MRO concepts to be competitive and efficient. SP

Digital Twins, Smart Equipment Technology, Drone Usage, Cloud-Based MRO Solutions, Blockchain, Augmented and Virtual Reality, and Additive Manufacturing are reshaping the MRO landscape, bringing efficiency, cost optimisation, and innovation to the forefront of the industry

PHOTOGRAPH: Airbus

Pratt & Whitney boasts a rich legacy of pioneering design and the relentless pursuit of enhanced propulsion systems

PIONEERING EXCELLENCE

Pratt & Whitney is at the forefront of aerospace innovation, propelling a journey from legacy to sustainability, characterised by pioneering excellence in aerospace propulsion, shaping the future of global aviation

BY **DR D.K. PANDEY**

PRATT & WHITNEY STANDS as a formidable entity within the global landscape of aircraft engine manufacturing, boasting a position of considerable magnitude, with its engines propelling a range of commercial airliners. According to the company, over 85,000 Pratt & Whitney engines are used in over 200 countries and territories. In 2022, the company had made $1.3 billion in adjusted operating profit on adjusted net sales of $20.5 billion. Today, it focuses on enhancing fuel efficiency, minimising emissions, and producing quieter engines.

EVOLVING PROFESSIONALISM. Pratt & Whitney has been at the forefront of aviation propulsion innovation for many years. Starting in the 1920s, it has continued to thrive over the years. A pioneer in the invention of the air-cooled radial engine, Frederick B. Rentschler, an Ohio native and former executive at Wright Aeronautical, was the company's founder. He established the Pratt & Whitney Aircraft Company in 1925. It was in 1928 that Pratt & Whitney Aircraft Company set up its division in Canada.

The gas turbine and jet propulsion programme at Pratt & Whitney started in 1944. The significant Technological Advancements came when it created groundbreaking engines such as the Wasp series, extensively utilised in military aircraft during World War II. The company built a wind tunnel, laboratory, and technical centre to aid allies in WWII. Over 3,00,000 Pratt & Whitney engines were manufactured in 1945 for the war effort. Engine users highly praised the reliability of these engines, and that reputation has lasted until this day. Pratt & Whitney became an engine design and innovation industry leader, producing more powerful, agile, and dependable engines.

PHOTOGRAPHS: Pratt & Whitney

Although the company achieved a prominent standing within the world of piston-propelled aircraft propulsion systems throughout the 1930s, it subsequently embarked upon a momentous shift towards jet engine technology during the early 1950s. Presently, Pratt & Whitney is exclusively engaged in the production of jet engines. In contrast, manufacturing smaller engines and those designed for propeller aircraft is entrusted to its Canadian counterpart, Pratt & Whitney Canada. Further progress has been made in developing jet engines, with the introduction of the JT3D for commercial use. Pratt & Whitney's commendable trajectory has been propelled by advancements in quality, heightened dedication to customer satisfaction, and unwavering commitment to technological progress.

QUALITY PRODUCTION. Although Pratt & Whitney faces competition from several major players in the aerospace industry, the company has maintained quality by utilising research and development (R&D) and innovative practices. Some notable commercial engines produced by the company include:

- **GTF:** Pratt & Whitney saved single-aisle aircraft 16-20 per cent in fuel consumption, cut NOx emissions in half, and reduced noise footprint by 75 per cent with the Geared Turbofan (GTF) engine, which they developed and pioneered with over $10 billion invested over 20 years. With the ground-breaking innovation, airlines have increased people connections while decreasing their carbon footprint by millions of tonnes. By introducing the GTF Advantage engine for the Airbus A320neo family of planes, P&W has proven that great power can also be sustainable. The GTF Advantage, the initial iteration of the GTF, provides significantly more thrust while also improving fuel consumption and CO_2 emissions by an extra 1 per cent.
- **V2500:** The V2500 engine powers the Airbus A320 family, the McDonnell Douglas MD-90, and the Embraer C-390 Millennium.
- **GP7200:** More than 25 years since the GP7200 was introduced. It has been utilised on the Airbus A380.
- **PW4000-94:** The PW4000 94-inch fan engine generates a thrust ranging from 52,000 to 62,000 pounds and is the initial variant in the PW4000 series of powerful engines. Pratt & Whitney has supplied over 2,500 PW4000-94 inch engines to commercial aircraft globally since 1987. These engines have accumulated a total of more than 150 million efficient flight hours. It powers Boeing 747, Boeing 767, MD-11, Airbus A300, and Airbus A310.
- **PW4000-100:** Pratt & Whitney has enhanced its successful PW4000 100-inch engine for the Airbus A330 by introducing the PW4170 Advantage70 programme. The Advantage70 technology offers enhanced engine performance, with a 2 per cent boost in thrust, a 1 per cent decrease in fuel consumption, improved durability, and lower maintenance expenses. Airbus A330-300, Airbus A330-200, and Airbus A330-200/300 are equipped with these engines.
- **PW2000:** The mid-thrust range of the PW2000 engine from Pratt & Whitney is 37,000 pounds to 43,000 pounds. The PW2000 engine propels all variants of the twin-engine Boeing 757 aircraft. It also serves as the sole power source for the four-engine C-17 Globemaster III military transport aircraft, specifically the F117 engine. The PW2040 type is also utilised as the propulsion system for the C-32A, which is the military variant of the 757 aircraft operated by the US Air Force.
- **JT8D:** Pratt & Whitney ushered in a new era in the field of commercial aviation in the year 1964 when they unveiled the JT8D engine to the world. This groundbreaking propulsion system debuted during the inaugural flight of Boeing's esteemed 727-100 aircraft, forever altering the course of aviation history. Aeroplanes Powered by JT8D are Aerospatiale SE210 Caravelle Super 10 Thru 12, Boeing 727, Boeing 737-100/-200, Boeing MD-80, McDonnell Douglas DC-9, Dassault-Mercure Breguet, Kawasaki C-1, and Super 27 Re-Engining Program.
- **JT9D:** Powerful wide-bodied aircraft like Boeing 747, Boeing 767, Airbus A300, Airbus A310, and McDonnell Douglas DC-10 are equipped with JT9D engines. JT9D engine opened a new era in commercial aviation as it was the high-bypass-ratio engine.

Pratt & Whitney's productivity records regarding engine shipments delivered from FY 2019 to FY 2021 are appended below:

Year	Large Commercial	P&W Canada
2019	746	2355
2020	546	1650
2021	623	1825

CHALLENGES FACED AND ROAD AHEAD. In recent times, the aviation industry has found itself at the intersection of various challenges stemming from geopolitical tensions, natural calamities, and the unprecedented global impact of the COVID-19 pandemic. These external factors have cast a formidable shadow over the progress and manufacturing processes of aero-engines, introducing significant hurdles and complexities. Like other engine manufacturers, Pratt & Whitney has also faced several impediments and challenges like innovation requirements and Supply Chain issues in aero-engine production. In navigating these multifaceted challenges, the company was not only confronted with the need for resilience but also with the imperative to chart a course towards sustainable practices, innovation, and strategic adaptability.

Staying ahead in the industry necessitates a commitment to continuous improvement and technological advancements and Pratt & Whitney was able to successfully address concerns related to durability, dependability, and overall performance by striking the right balance between efficiency, affordability, and minimal environmental impact.

Frederick Rentschler, founder of Pratt & Whitney, opined, "The best aeroplane could only be designed around the best engine". Adhering to the vision, Pratt & Whitney boasts a rich legacy of pioneering design and the relentless pursuit of enhanced propulsion systems, establishing itself as a dominant force within the aerospace domain. To maintain an unparalleled standing in the field of aero-engine design, it is imperative to consistently exert diligent and unwavering endeavours. Pratt & Whitney is geared towards

Pratt & Whitney's commendable trajectory has been propelled by advancements in quality, heightened dedication to customer satisfaction, and unwavering commitment to technological progress

Pratt & Whitney continues to be a reliable power source for hundreds of airlines and operators, with more than 13,000 large commercial engines installed to date

the developing and producing future engines with higher efficiency, lower pollution, and longer lifespan. The company is prioritising developing sustainable aviation by directing efforts towards creating more fuel-efficient and environmentally conscious engines. Innovations in hybrid-electric and hydrogen-powered propulsion systems signifies a promising trajectory towards advancing sustainable transportation solutions in the foreseeable future.

INDIA AND PRATT & WHITNEY. Pratt & Whitney boasts a substantial footprint within the Indian market. Notably, the company has forged a strategic alignment with the Indian government's initiatives, including the renowned 'Make in India', 'Skill India', and 'Start-up India' programmes. Through the establishment of engineering centres and the strategic recruitment of local talent, Pratt & Whitney actively contributes to the advancement of domestic production capabilities and the generation of employment opportunities. Moreover, their diligent efforts in enhancing the efficacy of aviation operations align seamlessly with India's overarching sustainability objectives.

The establishment of the Pratt & Whitney India Engineering Centre in Bengaluru in January 2023, is a testament to its commitment to expanding its global footprint and fostering innovation in the engineering field. This establishment is primarily dedicated to the comprehensive examination and analysis of aero, mechanical, and control systems pertaining to commercial engines. Notably, it encompasses the meticulous scrutiny of cutting-edge technologies such as the Geared Turbofan and PT6. The central establishment intends to engage approximately five hundred engineers and professionals upon reaching its maximum staffing capacity.

The expansion of Pratt & Whitney in the Indian market exemplifies the robust interconnections and profound reverence the company holds for India's proficiencies, which are indispensable for the forthcoming trajectory of the aviation industry. Pratt & Whitney has been an integral part of India's aviation industry for more than half a century. Some of their key milestones are:

- **Engine Supplier:** Pratt & Whitney is a major supplier of engines to India's commercial and military aircraft fleet. Airlines in India, such as IndiGo and GoAir, rely on their engines for their Airbus A320neo and A220 planes. They also supply engines for SpiceJet and Air India's Boeing 737 and 787 planes.
- **Transfer of Technology:** Pratt & Whitney has worked with Indian businesses to transfer engine technologies and manufacturing skills. Because of this, India has been able to advance its own programmes for aviation engines.
- **Support and Training:** Pratt & Whitney offers engineers and technicians in India training programmes on repairing and maintaining engines. They back airlines in India with repair centres and depots for spare components.
- **Innovations:** Pratt & Whitney is devoted to creating new engines that are more fuel-efficient. Technologies such as hybrid electric propulsion systems and geared turbofan engines are now under development; these might help Indian airlines reduce fuel expenses and pollution.

CONCLUSION. Pratt & Whitney continues to be a reliable power source for hundreds of airlines and operators, with more than 13,000 large commercial engines installed to date. The company stands as a dominant force in the industry of propulsion systems on a global scale, commanding the capability to energise the most cutting-edge aircraft known to humanity. Moreover, the organisation is actively moulding the trajectory of aviation's forthcoming era.

Pratt & Whitney's projects in India serve as a compelling testament to the inherent capacity of multinational enterprises to actively contribute towards India's pursuit of self-sufficiency. Their dedication to advancing India's aerospace industry is evident through their strategic investments in indigenous talent and infrastructure and their harmonisation with governmental initiatives. Pratt & Whitney is in an ideal position to contribute to the future success of the Indian aviation sector, which has helped it grow substantially. SP

India has the world's fastest-growing population of high-net-worth individuals (HNWIs) and corporations, many of whom see helicopters as a luxurious and time-saving mode of transportation

AN UNTAPPED POTENTIAL

The under utilised capabilities of helicopters in India highlights the need for Government and Ministry of Civil Aviation assistance to navigate various challenges and leverage the abundant opportunities available

BY **SWAATI KETKAR**

INDIAN AVIATION IS ONE of the fastest growing aviation markets globally having third largest market in terms of domestic capacity following US and China. In 2023, a whooping 133 new planes were inducted by different commercial airlines recording a 51 per cent rise over 2022. The post-COVID Indian civil aviation recovery market is soaring. In comparison, a rather gloomy picture greets the eye when we ponder over the helicopter industry in India. A little deep study into the helicopter market, leaves one with a lot of debatable questions like what exactly is lacking, why is India's helicopter market still untapped? Why does a country with a population of 140 crores and counting has a mere 250 helicopters with just 1,900 heliports? Such figures make one wonder – Why is the helicopter industry receiving step-motherly treatment at the hands of the Ministry?

One of the key reasons for this stagnation as per Airbus is perception of helicopters in the minds of Indian population at large that 'helicopters are only for rich.' Due to this mental image the citizen has largely remained disconnected from its benefits and Governments have baulked from backing an idea that does not resonate with the masses. Echoing these views, Amit Dutta, Managing Director, Hunch Mobility, feels that helicopters are often perceived as a luxury reserved for VVIPs, celebrities, and politicians, overshadowing their fundamental role in enhancing accessibility to remote destinations and providing unparalleled

PHOTOGRAPH: Airbus

efficiency. This perception that helicopters are exclusively for the elite has contributed to their underutilisation in addressing broader transportation needs. Along with perception, there is a lack of awareness regarding the efficiency and convenience of helicopters especially regarding the accessibility in remote locations adds Dutta. "This limited fleet is further compounded by underutilisation of helipads and burdened with regulatory hurdles."

Globally, employment of helicopters in law enforcement and emergency medical services enhances their operational viability. In India, these services are practically non-existent. "Poor consumer demand resulting in limited growth is a relevant challenge while alienation to technology absorption impeding this demand is unexplainable," says Captain Peeyush Kumar of HeliGo Charter services. Countries leading the 'pack' of helicopter operations like Norway, Switzerland and Germany, have embraced helicopter-based transfers under Performance Based Navigation (PBN) concept which is a helicopter-specific operational alternative developed by ICAO for all weather, day/night operations from heliports. "Indian helicopter sector on the other hand is content with its legacy 'sunrise-sunset, good-weather-only' window from heliports. It is only unfortunate that the dismal safety record of helicopter accidents possible to be offset through aforesaid PBN based operations remain estranged in India," Captain Kumar adds. Additionally, poor safety record, non-reliability of planned schedule owing to traditional heliport operations are the primary tie-downs of Indian helicopter industry.

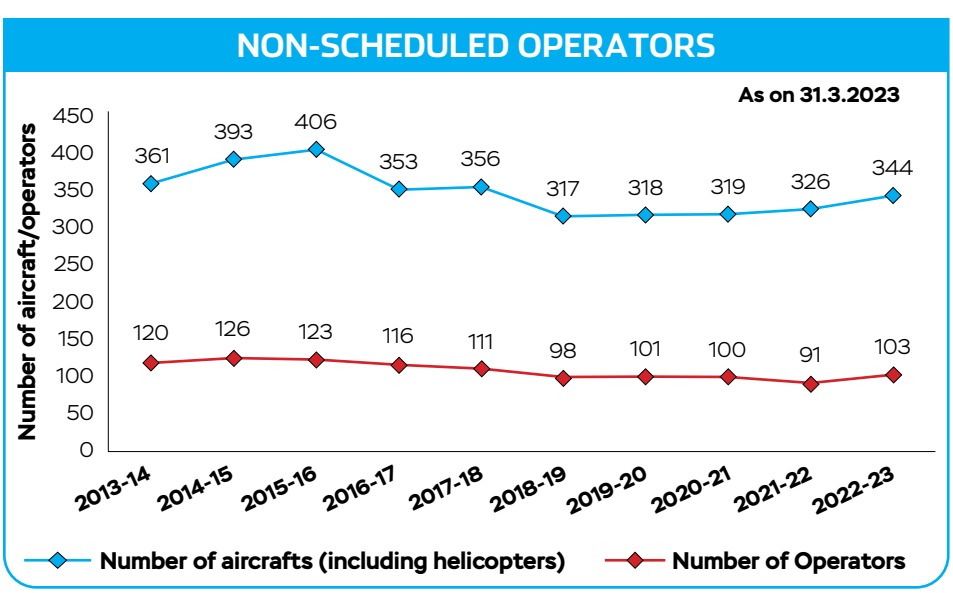
The scope of helicopters for tourism in India is vast and exciting, offering unique experiences and access to breathtaking locations that would otherwise be difficult or impossible to reach

Meanwhile Vman has become the first private Indian lessor to sign a memorandum of understanding with Hindustan Aeronautics (HAL) to form a joint venture for leasing aircraft. As agreement was signed with Hindustan Aeronautics Limited to lease five light utility helicopters (LUH) with options for five more. The civil version of the LUH is expected to be rolled out in 2025.

Moreover, the ease of purchasing helicopters has historically presented a challenge. However, initiatives like GIFT City are now playing a pivotal role in streamlining the acquisition process, potentially opening up new avenues for the industry. Dutta claims that simplifying acquisition procedures will be crucial in unlocking the full potential of the helicopter industry in India. Lack of the management capability to handle complex operations like HEMS, URBAN mobility, and PBN operation are also critical factors dragging the helicopter industry behind.

WHY IS THE HELICOPTER SECTOR STILL LAGGING BEHIND? India currently lacks an operator with adequate size to drive growth and expand in virgin areas, says Vishok Mansingh, Chief Executive, Vman. The new and existing operators need access to funding and leasing of helicopters in India. "Vman is focusing on leasing helicopters to those who are not able to access assets from international leasing companies due to weak balance sheets or inadequate collateral," comments Mansingh. According to him, the current VGF under RCS UDAN is inadequate with the current cost of the operation of the helicopter. This is holding the development of a new route under UDAN.

PHOTOGRAPH: Heritage Aviation



Source: Directorate of Air Transport- I

The scope of helicopter operations in India's offshore industry is constantly evolving and demand for these machines is expected to rise further

POTENTIAL CORRECTIVE STEPS TO OVERCOME THE CHALLENGES. Of the 250 helicopters, about 181 are have the Non-scheduled Operator's Permit (NSOP), 26 of them fall under the ambit of various state Governments like Maharashtra, Uttar Pradesh and more while the rest belong to privately-owned by individuals and corporates, as per the latest data by Ministry of Civil Aviation.

There is a vast gap in the fleet operator with Pawan Hans owning over 40 helicopters at one end of the spectrum while certain private operator owning just one helicopter. Only three operators have more than two-digit fleet out of 40 + operators while most of the operators have just a helicopter fleet ranging from 1 to 5. "For sustainable and long-term growth, we need a well-funded operator who can build up an adequate size of fleet of different types to serve different segments with economies of scale," comments Mansingh. "This will also help in the long-term development of adequate critical manpower for future growth." Mansingh adds. Seconding Mansingh's views, Dutta claims that additionally there is a need for morecomprehensive policies addressing issues such as the development of dedicated corridors forhelicopter flights, landing charges, and fuel costs to foster industry growth.

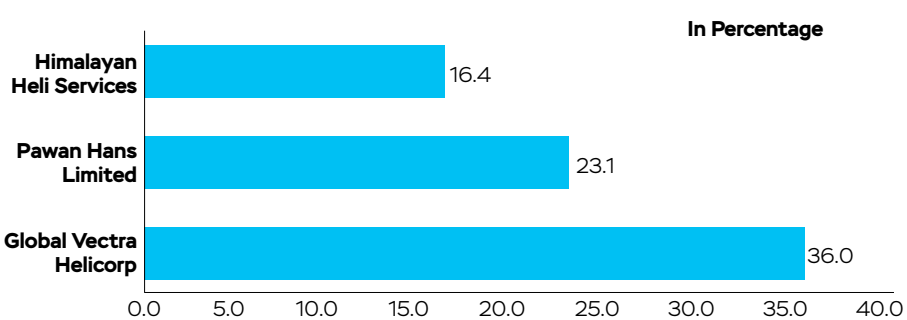
In India, single engine (Instrument flight rule) IFR and single engine night operations are not permitted in India at present as single engine helicopter is perceived as unsafe. Perceiving this rule as obsolete, B.S. Singh Deo, Vice President of Rotary Wing Society of India asserts that modern single engine helicopters are as safe as the twin engine one so there is no justification for restrictions on SE helicopters.

India's strategic location in terms of size, varied terrains, scattered population settlements, economic growth and much more places India as one of the top contenders amongst developing helicopter markets in the world. In fact, India has the potential to be amongst the world's biggest civil helicopter using countries, claims Airbus. "Hence now, the onus is both on the Government and industry players like ourselves to de-glamourise helicopters and position it for greater acceptability," Airbus adds. "The final stakeholder MoCA (Ministry of Civil Aviation) however could inject limited but decisive growth through a top-down approach, should the willing authorities be adequately persuaded," concludes Captain Kumar.

EXPECTATIONS FROM THE GOVERNMENT. However, all hope is not lost! The Government is trying to do its bit for the helicopter industry. Like last year, helicopters were included in UDAN 5.1 to achieve last mile connectivity. This means an increase in the scope of operations and increased viability gap funding for sustainable operations. "This means a move towards a deeper democratisation of air travel with a focus on last mile connectivity," Airbus comments praising this step as a significant step towards development of helicopter industry in India.

In 2021, the Ministry announced a new helicopter policy under which dedicated hubs and corridors would be established and landing charges and parking deposits abolished

TOP 3* NON-SCHEDULED HELICOPTER OPERATIONS (% SHARE), 2022-23



* In terms of number of flights operated.

Out of 50 non-scheduled Helicopter operators, top 3 operators accounted for more than 75% of the total number of flights operated in the year 2022-23.

Source: DGCA

PHOTOGRAPH: Pawan Hans

to boost commercial helicopter operations in the country. Under the new policy, the Government has put together a dedicated helicopter acceleration cell in the Civil Aviation Ministry to look at helicopter industry's issues. As part of the policy there are no landing charges or parking deposits for heliports or helicopter companies. About four Heli Hubs and Training Units will be set up in Mumbai, Guwahati, Delhi, and Bengaluru and helicopter corridors are being set up in 10 cities and 82 routes in the country.

Worldwide, helicopters are seen as an integral part of any public service delivery be it emergency health transportation, disaster response, law and order or urban mobility. Airbus believes in India's potential as a bludgeoning giant ready to emerge any day as a major player in the helicopter market. "India is ready for the use of helicopters as a critical component of public service delivery. There is a latent appetite for on-demand air mobility not only in the urban areas but also in many parts of your mountain states," Airbus reasons.

Industry stakeholders have various expectations from the Government with regards to the helicopter industry. Mansingh feels the Government should start with initiating fractional ownership to increase access to capital for the helicopter industry. Just recently the MoCA has decided to allow fractional ownership of business jets and helicopters to spur the growth of non-scheduled operations in the country.

Globally, employment of Helicopters in Law Enforcement and Emergency Medical Services enhances their operational viability. In India, these services are practically non-existent.

The Government can also help reform certain rules like revising the helicopter VGF and aligning it with the current operating cost and increasing it to five years to make it operational economically viable and RCS sectors. "Various state needs to step in for infrastructure -Heliport, Helipad and Navigation aid and procedure development," Mansingh urges.Echoing Mansingh's thoughts, Dutta also feels that Government should incentivise processes for leasing of helicopters in India. He further urges the Government to provide dedicated air corridors ensuring timeliness for flights.

Tax on helicopter flights is 18 per cent at par with business class tickets whereas Economy seats in commercial aviation is five per cent. Dutta asserts that these taxes should also be at par with the economy tomake it more democratic. B.S. Singh Deo places his bet on the large untapped skilled labour in India. He feels skill development and training should be initialised by setting up more training schools to address pilot shortage issues that are already being experienced. He also shares Captain Kumar's perspective that rule need to change and become more liberal to allow highly experienced ex-defence pilots and engineers to get commercial licenses.

Currently there are about 35 flying training organisations and six aircraft Type Training Organisations (ATOs) for fixed-wing training as per DGCA records. The Bengaluru-based Helicopter Academy to Train by Simulation of Flying (HATSOFF) is the only helicopter training facility, and that too with a limited quota of simulators. Although setting up of setting up of India's first helicopter ATO, FlyOla, has been approved as of now there is no dedicated training organisation offering training for a Commercial Helicopter Pilot's Licence.

Captain Kumar feels that the reported shortfalls related to short distance segments via CAG report no. 22 of 2023 on RCS-UDAN scheme are highly resolvable by efficient helicopter operations since befitting their core competency zone. 'Icing on the cake' is expected role of RCS-UDAN scheme in nation building initiative of 'Gati Shakti'. Highlighted potential of helicopter sector to support RCS-UDAN scheme via its core competency in small distance segments would thus be an impetus for national 'Gati Shakti' initiative. Another shot in the arm would be employment of indigenous GAGAN system for heliport infrastructural development towards RCS-UDAN connectivity. Interest of the apex stakeholder, MoCA must therefore be agreed upon," Captain Kumar adds.

A detailed talk with various industry experts and stakeholder let to the following preliminary observations and steps needed to be taken for helicopters in India to take-off, to establish feasibility and later scalability of a 'Pilot' project:

- **Development of Heliport Infrastructure under IFR (Instrument Flight Rules):** The Government needs to look at the hilly terrain withlimited road connectivity in Northern and North-Eastern Regions as a base for its 'pilot project' to gain maximum advantage. AAI can develop about two to four heliports with IFR infrastructure under PBN concept for linking up with identified airport(s) under RCS-UDAN scheme.
- **Single-Pilot Helicopter Operations under IFR:** Proposed initiatives necessitate larger population of skilled pilots. DGCA may consider measures for complementing population of trained helicopter pilots to match projected scope of nation-wide operations. Facilitating single pilot operations under IFR is one viable solution to the challenge. To put things in perspective, single pilot operations under IFR are already provisioned for aircraft in India, but capped for helicopters. This 'cap' restricts scope of operations and possibly impacting contribution by helicopters in nationwide schemes.
- **Participation of Private Helicopter Operators:** Role of Pawan Hans in shaping helicopter operations under RCS-UDAN scheme has been far from praiseworthy. It may therefore be considered to invite private sector helicopter operators for wider participation and possibilities at planning levels. Economic prudence for self-sustainable operations may also be better reflected by private sector as required under RCS-UDAN scheme. The most important advantage would however be deliberations on contemporary ideas for an upward trajectory.

CONCLUSION. While helicopter policies have been liberalised, there is a long way to go. Currently helicopters policies are seen in the same lens as aircrafts whereas the helicopter is more versatile machine andpolicies need to be crafted accordingly. Going ahead India must boost the use of helicopters for the purpose of effective internal surveillance, maintenance of law and order and traffic, and civic management as part of the 'SMART Cities' project. SP

BY **RYAN WEIR,**
VICE PRESIDENT OF COMMERCIAL SALES AND MARKETING FOR INDIA, BOEING COMMERCIAL AIRPLANES

BOEING SUPPORTS INDIAN AIR CARGO GROWTH

India's cargo aviation industry expands through partnerships for resource development and technological innovation to meet growing air cargo demand.

INDIA'S AIR CARGO INDUSTRY initially suffered during the COVID-19 pandemic as South Asian imports and exports faced disrupted supply chains, closed borders and hampered movement. However, Air Cargo to key regions started rebounding in 2022, and that recovery has continued.

India dominates South Asian freight traffic today. In 2021, India was responsible for more than 60 per cent of South Asia's imports and exports. The top four airports by freight traffic were located inside India's borders. The same year, Europe supplanted East Asia as South Asia's top air cargo trading partner, with total trade surpassing 8,17,000 metric tonnes.

India's Air Cargo fleet (less than 15 airplanes) relative to a GDP of over $3 trillion indicates a huge opportunity for significant fleet growth as GDP growth remains strong and resilient. The Indian Government and the aviation industry, including Boeing, are partnering to develop this key economic opportunity in multiple ways.

Boeing 777 Freighter Fleet

PHOTOGRAPHS: Boeing

CARGO OUTLOOK AND DRIVERS. From the rise in e-commerce for consumer goods to demand for general freight, Boeing forecasts the world freighter fleet to grow more than 70 per cent over the next 20 years.

The current baseline growth scenario is 60 basis points higher than Boeing's 2020 forecast, driven by India's strong economic recovery as well as a base year (2021) that had 19 per cent less tonnage than 2019 due to the pandemic. The Make in India campaign is a primary growth driver in both imports (machinery and chemicals) and exports (finished products).

Boeing anticipates a demand for more than 75 freighters, including production and converted freighters, to meet India's growing cargo demand. The majority of the cargo fleet will consist of converted standard-body aircraft for domestic and regional growth, along with a number of production and conversion wide-body freighters for global operations.

Boeing forecasts India's air cargo growth to average 6.9 per cent annually over the next two decades, driven by the country's manufacturing and e-commerce sectors. The rise of e-commerce is seen particularly in emerging markets with underdeveloped ground and postal networks. Manufacturing-driven cargo includes the rise of high-end electronics such as smartphones and wearables, along with other value-added manufacturing, such as semiconductors.

BOEING'S CONTRIBUTIONS TO THE INDIAN CARGO MARKET. Boeing freighter and Boeing Converted Freighter operators in India include SpiceExpress, Blue Dart and Quikjet.

Passenger-to-freighter conversions such as the Boeing 737BCF and 767BCF offer commercial airplane owners an opportunity to realise the greatest value from their airplane assets in preparation for the long-term growth projected for the air cargo industry. India also has an opportunity for production freighters that include the 767F, 777F and 777-8F as the country's cargo network can expand to provide nonstop flights to Europe, North Asia, Oceania and North America.

Recently, Boeing announced an agreement with GMR Aero Technic to establish a new Boeing Converted Freighter line in Hyderabad. GMR Aero Technic is the first Boeing supplier in India that will have the capability to support future conversions of both domestic and foreign aircraft.

The collaboration with GMR Aero Technic supports the anticipated growth of the cargo sector and contributes to India's aspiration to become a regional aviation and aerospace hub.

INFRASTRUCTURE DEVELOPMENT. The Indian Government's focus on the Air Cargo sector is expected to help the industry grow rapidly in the coming years. India's commitment is evident through substantial investments in new airports, expansion of existing ones, and the construction of state-of-the-art Cargo terminals.

The Government's National Air Cargo Policy, introduced in 2020, streamlines the regulatory environment, making it easier for businesses to import and export goods by air.

Boeing's collaboration with GMR Aero Technic to establish a BCF line in Hyderabad helps expand complex aircraft modification capabilities and Maintenance, Repair and Overhaul (MRO) in India. The agreement also testifies to the maturation of Indian MROs in the country to support the vision of Atmanirbhar Bharat.

WORKFORCE TRAINING. India's aviation growth is intensifying demand for skilled professionals across the industry. Recognising this need, Boeing recently announced a $100 million investment in infrastructure and programmes to train pilots in India. This investment will support the country's requirement for new pilots over the next two decades.

Boeing's focus on building and enhancing pilot training academies, maintenance training capabilities, and simulator capacities within India reflects its commitment to the country's goal of transforming the training landscape. Aspiring professionals in the aviation industry can expect ample opportunities for growth and development within India, thanks to the collaboration between industry stakeholders like Boeing and the Government.

India's long-term forecast growth in air traffic, along with the availability of a large pool of skilled aviation technicians and engineers, positions the country well to become a key regional player in the commercial aviation sector.

TECHNOLOGY INNOVATIONS TO INCREASE EFFICIENCY. Technology plays a pivotal role in revolutionising air cargo operations through streamlining processes and enhancing overall efficiency. It was a key topic at the India Air Cargo Symposium presented by Boeing in 2023. Industry stakeholders discussed strategies that would overcome challenges and make the most of opportunities to grow.

For example, by automating manual tasks, such as data entry, tracking and scheduling, technology frees up employees to focus on more strategic endeavours while reducing the likelihood of human error.

Real-time visibility into cargo shipments is made possible through tracking software. Technology also reinforces security by proactively identifying and addressing potential threats.

Cutting-edge software optimises routing, minimising costs and improving delivery times by considering factors such as traffic, weather, and fuel prices. Seamless communication among stakeholders in the cargo supply chain, including shippers, carriers, and customs officials, ensures streamlined processing and mitigates delays.

Boeing also has introduced technology innovations that increase air cargo efficiency. In early 2023, the company launched its first India-based Global Support Centre in Gurgaon. The Centre will deliver customised operational-efficiency and safety-improvement projects for Boeing's airline customers, civil aviation regulatory bodies and other industry stakeholders.

Meanwhile, Boeing Research & Technology-India has delivered commercially viable solutions for Airplane Health Management and Air Traffic Management (ATM). The company's ATM experts are working with the Airports Authority of India to develop a roadmap for the modernisation of air traffic management in the country.

By leveraging technology, Boeing aims to enhance the overall performance and competitiveness of the Indian air cargo industry.

BOEING'S COMMITMENT TO INDIAN AVIATION. With over eight decades of presence in India, Boeing has built a strong network of support for its customers in the region. Through multiple initiatives and partnerships, Boeing demonstrates its commitment to supporting the growth of Indian cargo and passenger aviation, contributing to the development of the Indian economy.

Boeing is honoured to collaborate with stakeholders across India in strategic partnerships, infrastructure development, workforce training, and technological innovations that will ensure the air cargo industry's growth and success. SP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