August 2023

100 KNOTS

India's Aviation Ecosystem

MRO
Growth of Commercial Aviation MROs

Safety
Understand Your Aircraft Oxygen System

Health
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Travel
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Airline
Akasa Air Celebrates Year One

A Kerospace Solutions Company

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EDITORIAL DESK

Radhika Bansal
Assistant Editor

Dear Colleagues,

Welcome to the August 2023 issue of the 100 Knots Magazine.

With great delight, we would like to commemorate a significant milestone in the world of aviation - the successful first anniversary of Akasa Air. It feels like just yesterday when they embarked on this ambitious journey, and today, as we look back, our hearts are filled with joy to see the remarkable progress and accomplishments they made. We extend our heartfelt wishes to Team Akasa for making this incredible year a resounding success.

In this issue, we will be joining Capt. Ghani and Faiz, who have just returned from a thrilling expedition to the roof of Europe. Dr Sanjay Bhargava talks about Pilot incapacitation as it remains a critical concern in aviation safety. He explains why Airlines and regulatory bodies must continuously prioritize stringent protocols, comprehensive medical evaluations, and crew training to minimize risks. Cdr Amogh Warhadpande (Retd) explains why India need initiatives to promote aviation in Civil / Military sector and provisions for incentives for Investment, Tax reforms and assistance for building Infrastructure for MRO. Abhishek Nayyar discusses aircraft supplemental oxygen systems and explains why caution needs to be exercises when checking/servicing oxygen systems.

As always, Contributions, comments, and feedback are always welcome. All papers are received with a high degree of enthusiasm and will find a home in future issues.

Our sincere thanks to all the contributors for their support and interest.

We hope to hear from you soon!

Happy Reading!

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Akasa Air Celebrates

A Year of Phenomenal Growth

Neelu Khatri
Co-Founder, Senior Vice President
and Head of Operations
Akasa Air

The Indian civil aviation industry is beyond resilient, having survived the unprecedented pandemic, when air travel was paused across the globe. The rebound in air traffic since then has been at a fast clip. India's substantial middle-class is expected to fuel India's aviation with more access to affordable travel, doubling from one in three Indian flyers to two in three by 2047.

By March 2023, bookings have bounced back to pre-Covid volumes for domestic trips and are nearly there for international trips. Domestic passenger capacity has exceeded the levels seen before the pandemic. Domestic air passenger traffic registered an annual growth of 36.1 percent in January-May 2023, over the same period in 2022, according to DGCA. Riding a quick recovery, Indian aviation is frequently clocking over 400,000 passengers a day since December 2022.

It is not just the metros of Delhi and Mumbai fuelling growth but a steady increase in traffic from tier II and III towns has led to bullish expectations for the aviation sector. The fact that Akasa Air has flown over 3.5 million passengers since its launch attests to the strong demand we have seen across the network. The aviation industry has been steadily recovering as a result of travellers' increased confidence in flying, and the trend will only continue.

Launch of Akasa Air and its successful 1 year of operations

It is safe to say that at Akasa Air, we have significantly been growing our operations since inception, with a fleet size of 19 aircraft, flying to 16 destinations across the nation. Our customers have expressed great appreciation for our industry-first offerings and customer-centric policies, which include allowing pets on board, providing USB connections, and a comfortable cabin environment. The fact that more than 3.5 million passengers have flown is a testament to the pent-up demand among flyers for an affordable airline that does not compromise on customer experience, and by embodying such a brand, we expect to continue to grow our business and service.

As a part of Akasa Air's initial order of 72 Boeing 737 Max aircraft, we will soon reach the milestone of 20 aircraft in the fleet. We have since then placed an order for four more aircraft, raising the total to 76 planes, and we also have plans to place another large three-digit aircraft order by the end of this year to meet the rising demand.

The Indian aviation industry is seeing a robust pick-up and is gearing up for rapid expansion in the next few years. It will lead to an exponential increase in demand and opportunities for pilots and cabin crew. At Akasa Air, all our talent strategies are rooted in employee-centricity, which has been our goal from day one. We base our hiring strategy on a candidate's ability to advance quickly in their career. We want to welcome talented individuals who want to begin their careers in the commercial airline business to join us and grow quickly. To improve operational efficiency, Akasa Air promotes a diverse and inclusive work environment. We are also in the process of rapidly expanding our fleet and network and are on the verge of placing a substantial aircraft order, mostly likely before the end of this year. We have been hiring pilots and cabin crew to meet our pace of growth.

While Akasa Air builds a strong national presence and offers connections from metros to tier II and III destinations nationwide, we are building on the airline's core goal of boosting accessibility to air travel for all Indians. Our phased approach to support our network plans, progressively connecting more cities, allows us to provide continuous, reliable, and efficient connections between aviation sectors/routes. To ensure that our services fulfil the needs and expectations of our consumers, we continuously consider feedback from customers to tweak our offerings and improve on them.

Making the sky affordable for everyone is part of Akasa Air's core founding vision and our way of serving the country. All of our efforts ultimately facilitate affordable air travel between rural and urban areas, and we'll keep expanding our network and product offerings to enhance the country's transport infrastructure.

© Sandeep Pilania

Future of the Indian Aviation Industry

India ranks third in the world by way of seat capacity for domestic air travel. India has 148 airports and with the recent budget announcements has added to the planned addition of aerodromes for boosting regional air connectivity under the government's Udan scheme. In addition to 100 airports already planned, 50 airports, heliports, waterdromes have been sanctioned to be built in the next couple of years.

The significant aircraft orders announced by Indian airlines signal a new era for the country's civil aviation industry. India's demand for air travel is at an all-time high, allowing both major airlines to grow and strengthen their operations and new entrants to establish themselves.

India now has roughly 750 aircraft but is expected to have around 1,200 by 2027, with the government providing robust infrastructure (including more ATC staff) to handle the increase in demand. India is estimated to see more than 140 million passengers flying in FY-2024, according to the civil aviation ministry. In the next 20 years, India will transport more than 1.3 billion passengers a year, estimates the Sydney-based CAPA Centre for Aviation.

Modern technology, automation, and evolving workplace paradigms have fundamentally changed how the aviation industry hires and engages employees. Given the expansion of the sector, airlines should place a high priority on providing their staff with the knowledge and skills to overcome challenges and take advantage of opportunities. Airlines are starting to use a variety of technologies, such as Metaverse, AR (augmented reality), and VR (virtual reality), for effective training and aircraft maintenance.

© Utkarsh Thakkar

Players are actively investing in technologies to minimize their carbon footprint and ensure sustainable operations because the global aviation sector has committed to net zero carbon emissions by 2050. The technology of blockchain will be used more frequently to track customer luggage and freight, enhance passenger identity verification, and automate payments. We could also see more widespread use of IoT (Internet of Things) for aviation maintenance, safety, and continuous monitoring. The sector is on the threshold of enormous expansion, and it will keep innovating with cutting-edge technologies that will make flying a seamless experience.

We may be the most populous country in the world but are underserved in terms of airline capacity. We need several airlines to fulfil such a surge in demand. The Indian aviation sector has a bright future, and the market is large enough for many carriers to profitably participate.

About the Author

Neelu Khatri is the Co-Founder, Senior Vice President and Head of Operations at Akasa Air. She comes with over 25 years of professional expertise and has spent most of her career in the Defense and Aerospace industry. She is an ex-Indian Air Force Wing Commander from the first batch of women officers back in 1993. Besides, she has also handled P&L for various global organisations, including Honeywell in India and served over five years working as a Director in the Civil Aviation and Aerospace department for KPMG. Moreover, she has authored numerous thought leadership documents on the regulations of the sector.

At Akasa Air, she is responsible for Operations Planning and Control, Airports, Maintenance and Engineering and Flight Operations.

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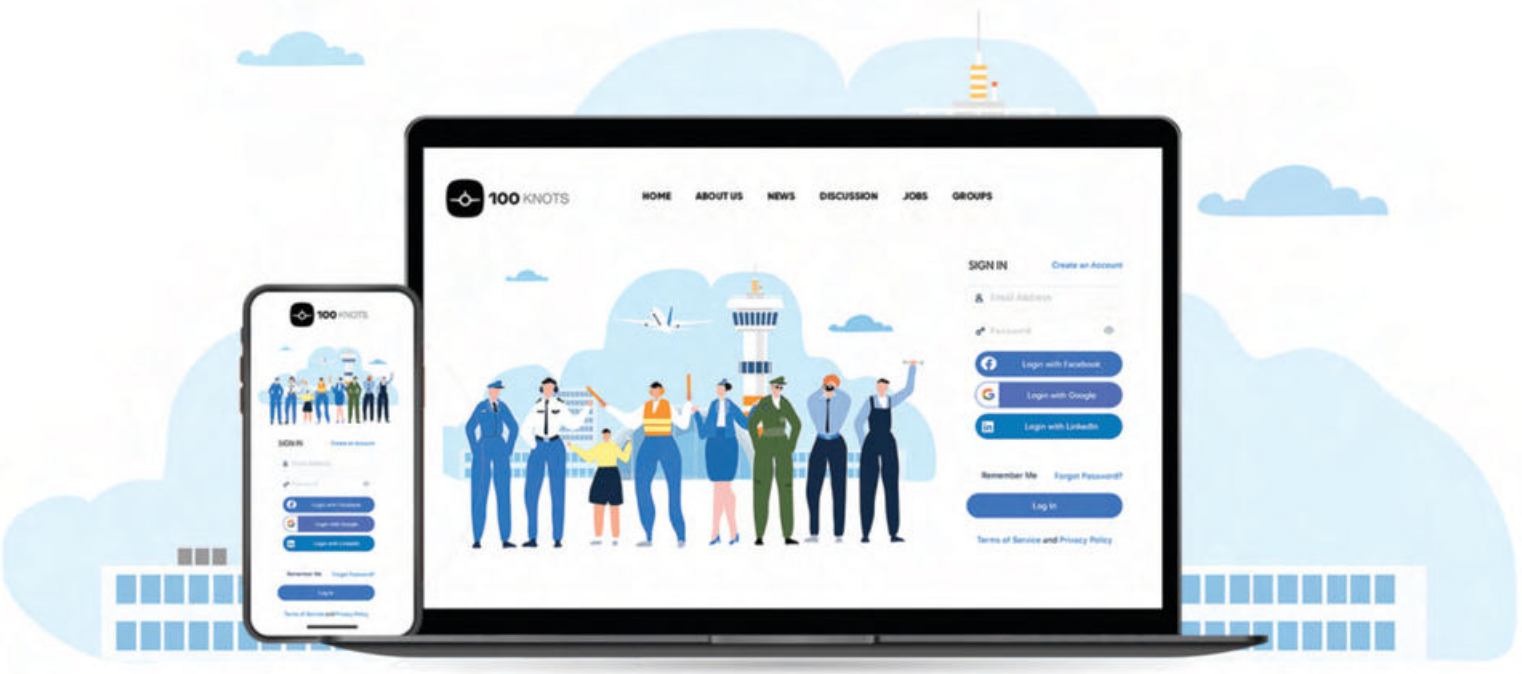


Mont Blanc

A Thrilling Expedition to the Roof of Europe

Capt Ghani Khan
Capt Faiz Khan

I will start with a confession! The first time I ever heard of these two French words could only relate a pen to it. I will blame my ignorance on the voracious marketing. During a trip to New York, I came across a book on the highest peaks in the world. It instantly hijacked my attention. First thoughts are the purest as doubt and or cortical calculation are yet to catch up with it. Being a fan of these pure moments, I grabbed the book and walked up to my room. Like a child, I turned the pages and came across this picture of a climber on the ridge hauling his way to the summit of Mont Blanc. Next attosecond, I could imagine myself in that climbing gear, breathing heavily and championing the trail to the summit.

Standing tall and proud at a staggering height of 4,809 meters (15,778 feet), Mont Blanc, meaning "White Mountain," is the highest peak in the Alps and the tallest in all of Western Europe. This iconic mountain has long captivated the imagination of adventurers and mountaineers, beckoning them to conquer its icy slopes and awe-inspiring beauty. Join us on an exhilarating expedition as we delve into the challenges, triumphs, and sheer magnificence of ascending the mighty Mont Blanc.

Preparing for the Journey

Ascending Mont Blanc is not for the faint of heart. The mountain's high altitude and extreme weather conditions pose significant challenges, hence requiring meticulous planning and physical preparation.

Duration
1 Week

Cost
3000 Euros

When to Go
The European summer season (June to September) is the best time to do it. That's when the huts are open and the conditions are the most optimal. In winter, temperatures are cold, huts are closed, the days shorter, and the increased amount of snow also means increased danger.

Acclimatize
Acclimatization is essential to adapt the body to thin air and lower oxygen levels at such altitudes. Sudden weather changes, including fierce winds, blizzards, and sub-zero temperatures, demand unwavering resilience and the ability to make calculated decisions in hazardous situations.

Weather & Equipment
Temperatures on the route range anywhere from +20°C at the starting point to -20°C at the summit. The higher parts of Mont Blanc can also experience extremely strong winds. Climbers must possess a good fitness level and undergo specialized training to tackle the technical aspects of the climb. It is crucial to equip oneself with proper mountaineering gear, including crampons, ice axes, harnesses, and ropes.

Safety
Sadly, Mont Blanc has highest fatality rate in Europe, with over 100 people perishing over the course of a season. Even though Mont Blanc is not difficult for those with more experience under their belt, it is still a high-altitude mountain covered in snow and any mountain like that can be fatally dangerous.

Route

There are lots of different routes up to Mont Blanc, reaching it from many different sides. The Gouter Route is the most popular route to Mont Blanc, hence it's named the "classic route". It is also the least technically demanding! The best place for a base of your climb is Chamonix, France.

Arrival in Chamonix & Meeting the Guides

Day 1-2

My younger brother Faiz, Komal, the yoga maestro, the calm adventurer Ashok and myself have pulled many uncomforting expeditions together. We have grown used to exhaustion, uncertainties, and chaos, which any expedition can throw at you with surprising randomness. We primed our aerobic motors for Mont Blanc for at least half a year before the due date. I recollect those days before the flight to Milan when we were even apprehensive of any ankle twists, back spasms, etc., as they could sour our dream.

The roar of the jet engines was milder than our elated hormones. Sitting in the flight deck for landing, I could see Mont Blanc's height on the navigation display with an increased scale.

A heartbeat of doubt did beat, but over the years, these expeditions have taught me to ignore the deceptive self. Ignorance was a short-lived bliss as I had to endlessly douse doubt with pepped-up self-talk. I kept it a bit private from Faiz as I got to put an elder brother's poker face sometimes. We took a bus to Chamonix in the French Alps, a village where adventure is as common as grocery shopping.

Here, we met with the guides, checked equipment, and hired additional boots, crampons, ice axes, etc., as needed. The next day we are driven to Italy to climb the highest mountain in the Italian Alps.

Day 3

Summit Gran Paradiso (4061m) and descent to The Chabod Hut (2750m)

We decided to leave early to take advantage of the hard overnight snow, which is much easier to walk on, attempt the Gran Paradiso 4061m summit, and descend back to The Chabod Hut. The head guide clarifies that only our fitness would take us there.
We all showed up with eagerness and were like toddlers for a while. It was time to show up with headlamps at 2 am; we were fully kitted with the rucksacks, energy gels, ice axes, harnesses, and helmets. We lift our heavy steps towards the homework mountain named Gran Paradiso. My longing to listen to the crampon rustle on the snow was getting quenched.

Faiz, Ashok, and I were on the same rope with an Italian guide. My experience is that Italians are super expressive. Our man was deserted of any encouragement, and we had to push with our sometimes weak self-talk. We came across a team that hit the wall and were returning without summiting the Gran Paradiso; the weather was gloomy, with fresh snowflakes caressing our helmets. The guides would converse in Italian and discuss the summit weather situation. I tried my best to decipher any clues from their body language.

We gave our might as a group and made it to the summit. This is where we come across the most exposed rocky traverse with a drop of death on both sides. With the crampon's front nicely tucked in the snow, we took apprehensive steps toward the summit. Faiz was almost in shock and could not help but share his worry about going back the same way. Descending back to Chabod hut was made in knee-deep snow at some places, and we had to find our way around our guide's sarcasm. We pushed through exhaustion physically and psychologically; in some stretches, our hormones propelled us, and we safely made it to the refuge for that day.

So, homework is done, and now we have the 11th most challenging mountain in the world, which is 800m higher and thrice as hard as Gran Paradiso.

Day 4 - 5 - 6

The Summit

We trekked to Tete Rousse hut, and I got euphoric. That is it! The expedition was designed to stay put at Tete Rousse for a night. The head guide briefed us to prepare for the summit day by 0330 am post breakfast. Ice boots, crampons, harnesses, helmets, headlamps, rucksacks, energy gels, and camelback with proper layering was the drill we all were in rhythm with.

Matthew signaled me outside, and after a final check, we got roped into taking on Mont Blanc. That push I was talking about earlier goes through the grand couloir, infamously known as the death corridor, as most Alps accidents occur here. Thankfully the snow prevented rockfall. I safely climbed the roughly 700m vertical section starting in pitch darkness in a comforting headlamp beam.

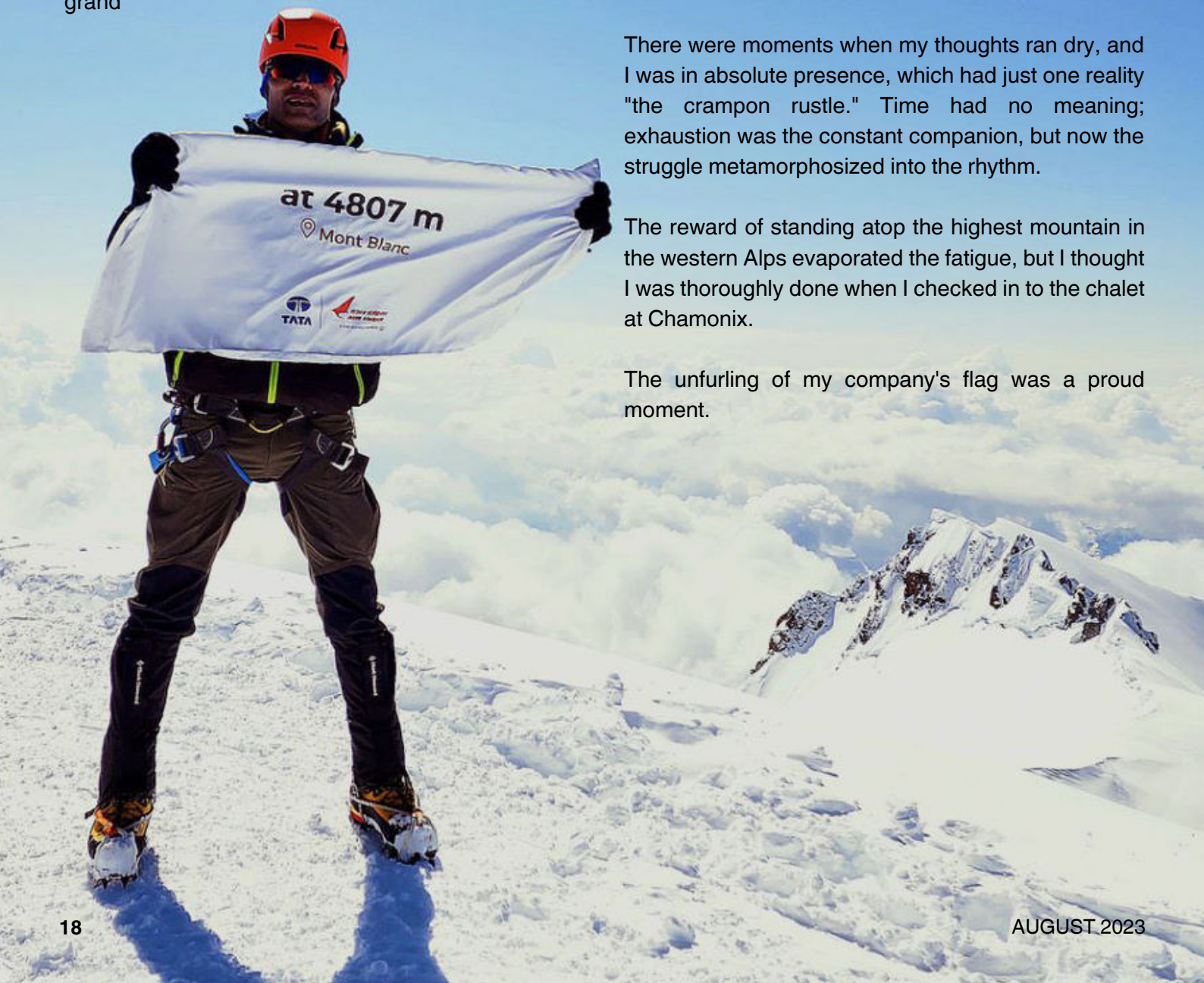
Matthew told me there was no stopping in this section, and I pledged to myself that if he stopped, I would stop or keep rustling the crampons on the snow.

We reached Gouter hut in one hour and twenty minutes, and after a brief snack, I became a minimalist.

There were moments when my thoughts ran dry, and I was in absolute presence, which had just one reality "the crampon rustle." Time had no meaning; exhaustion was the constant companion, but now the struggle metamorphosized into the rhythm.

The reward of standing atop the highest mountain in the western Alps evaporated the fatigue, but I thought I was thoroughly done when I checked in to the chalet at Chamonix.

The unfurling of my company's flag was a proud moment.



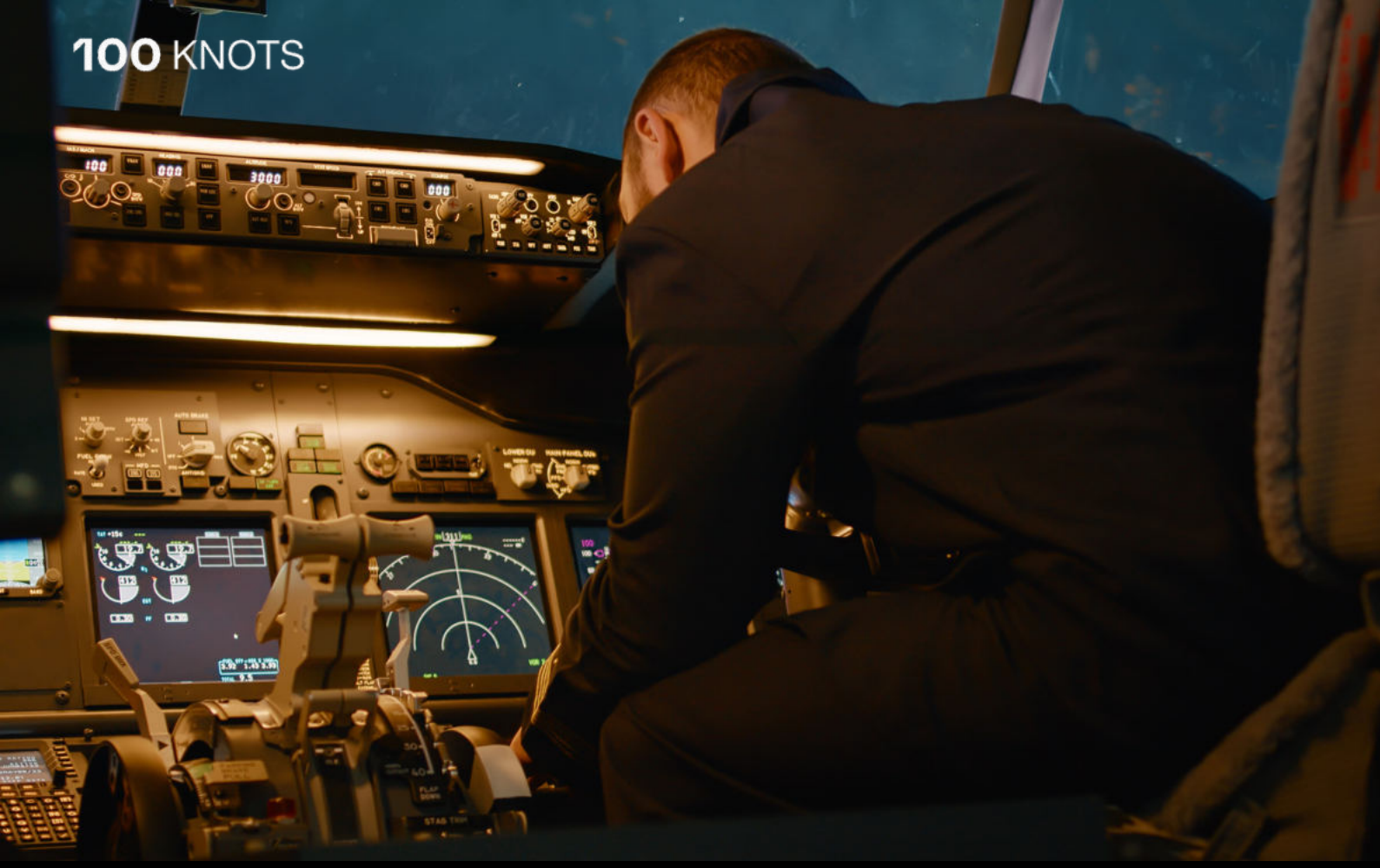
Final Words

Reaching the summit of Mont Blanc is an unparalleled triumph and a moment of pure exhilaration. As we persevere through physical and mental obstacles, the reward lies in breathtaking panoramic views of snow-capped peaks, glacial valleys, and the sprawling beauty of the Alps. The sense of accomplishment and the camaraderie formed with fellow climbers create memories that last a lifetime. We had the best possible weather conditions, and I am in awe and gratitude for how a quantum of a dream could materialize into an astronomical reality of this dream.

This expedition is an adventure of a lifetime, offering an extraordinary blend of physical challenges, breathtaking landscapes, and personal triumph. As we ascend toward the roof of Europe, we experienced the thrill of conquering nature's grandeur while being humbled by its immensity. The expedition instills a sense of respect for the mountains and a deeper appreciation for the beauty and fragility of our natural world. So, gear up, prepare yourself, and embark on a Mont Blanc expedition to create memories that will stay etched in your heart forever.

About the Author

Air India captain Ghani khan is an adventure and fitness enthusiast at heart. When he is not commanding his Dreamliner, Ghani explores his passion as adventure seeker, traveler, photographer and triathlete. He has clocked north of 10,000 hours in his 18-year career as an Air India Pilot. He has also endured four triathlons and travelled to all seven continents with two of his pictures featured by National Geographic. Ghani is presently based out of Gurugram where he resides with his wife Subuhi and two children Zayaan and Izna.



Handling

Pilot Incapacitation Inflight

Dr. Sanjay Bhargava MD
Consultant Aerospace Medicine Specialist

On 21 September 2021, Blue Dart Boeing 757 aircraft VT-BDN was involved in an incident of Pilot Incapacitation while operating scheduled cargo flight BZ-201 from Kolkata to Delhi. The aircraft was under the command of pilot an ATPL holder with First Officer a CPL holder.

During approach at Delhi when the aircraft was on LOC intercept Heading for RW11, First Officer exhibited seizure like activity and became unresponsive thereafter. First Officer was pushed back in to her seat immediately by the PIC and PIC locked her shoulder harness. The landing checklist was accomplished by PIC and subsequently a safe landing was carried out at Delhi. There was no damage to the aircraft. There were no fire and no injury to any of the occupants on board the aircraft.

DGCA investigation concluded that the probable cause of First Officer incapacitation was a Syncope. The definition of syncope implies an episode of transient loss of consciousness which is both rapid in onset and in resolution. A decrease in cerebral blood flow, usually precipitated by a fall in systemic blood pressure, almost always results in a physical collapse followed by an immediate and spontaneous recovery. Syncope is both incapacitating and unpredictable, presenting a significant challenge in aircrew assessment. It is, however, a relatively common symptom in the general population and accounts for up to 3 to 6% of all hospital admissions reporting transient loss of consciousness. Aircrew experiencing a syncopal event usually require a period of time off flying and the application of an Operational Multi-Crew Limitation (like PIC with QEP) which permits flying only as or with a qualified copilot, in order to reduce the risks associated with recurrence.

Pilot Incapacitation

Pilot Incapacitation is the term used to describe the inability of a pilot, who is part of the operating crew, to carry out their normal duties because of the onset, during flight, of the effects of physiological factors.

Incapacitation is a real air safety hazard that occurs more frequently than many other emergencies in routine aviation training. It can manifest itself in a variety of ways ranging from obvious sudden death to subtle, partial loss of function, not preceded by any warning. A partial incapacitation may be much more subtle to detect than a total one.

Although most recorded deaths of operating pilots in flight have been found to be due to cardiovascular disease, by far the most common cause of flight crew incapacitation is gastroenteritis.

1	Uncontrollable bowel action (21%) and "other" gastrointestinal symptoms (54%)	75%
2	Earache/blocked ear	8%
3	Faintness/general weakness	7%
4	Headache, including migraine	6%
5	Vertigo/disorientation	4%

Types of Pilot Incapacitation

The two basic types of pilot incapacitation are:

Obvious Incapacitation - Obvious incapacitation is frequently sudden, usually prolonged and usually results in a complete loss of operating function, generally will be easily detectable by the remaining flight crew members [generally will be easily detectable]. Among possible causes of obvious incapacitation are heart disorders, severe brain disorders, Internal bleeding, food poisoning, etc.

Subtle Incapacitation - Subtle incapacitation is frequently partial and often transient (for periods of seconds or minutes). It presents a significant operational hazard because it is difficult to detect by other crew members and the effects can range from partial loss of functions to complete unconsciousness. Among the possible causes of subtle incapacitation might be:

- Minor brain seizures
- Hypoglycemia (low blood sugar)
- Other medical disorders
- Extreme fatigue or preoccupation with personal problems, etc.

While Undergoing your Medicals

While undergoing annual medical examination, the medical examiner should would be particularly interested in anything that may indicate a risk for sudden incapacitation. He would be especially checking for Cardiac, metabolic (diabetes etc) and psychiatric causes. It is difficult for him to pick up in a brief medical encounter unless the individual is overtly psychotic, and sometime the staff notices unusual behaviour first. Most of the aircrew, even if undergoing a mild to moderate psychiatric episode, can make their way through the half-hour aviation medical. Therefore, while with the doctor you need to discuss frankly all your medical issues and stresses which you are facing so that proper medical intervention can be done at the right time without the risk of inflight incapacitation."

Prevention

Crew Members

- Don’t report for duty if not perfectly well
- Seek professional help for physical and mental health issues
- Maintain a Healthy lifestyle and nutrition
- Only use prescribed medication
- Limit yourself to moderate consumption of alcohol
- Get adequate sleep before duty

Organizations

- Flight and Cabin Crew needs to be trained adequately to raise awareness of incapacitation.
- Refresher training programmes should review the subject and include discussion of notified cases of flight crew incapacitation.
- Strict adherence to standard operating procedures
- Talk to your colleague if you suspect any discomfort
- Routine monitoring and cross-checking of flight instruments and crew actions, particularly during critical phases of flight; The use of challenge and response concept in completion of checks and drills;
- The use of crew concept of operation, which integrates the functions and actions of a flight crew and requires that each members’ action is monitored by another
- The use of the “Two Communication Rule”- flight crew members should have a very high degree of suspicion of a subtle incapacitation - whenever a flight crew member does not respond appropriately to two verbal communications, or whenever there is no appropriate response to any verbal communication, associated with a significant deviation from a standard flight profile.

Recognition

The initial signs of crew incapacitation can be very subtle and may not be immediately obvious to other crew members. Early recognition of incapacitation is essential:

- Routine monitoring and cross-checking of flight instruments, especially during critical phases of flight.
- Flight crewmembers should be alert to subtle incapacitation:
  - If a crewmember does not respond appropriately to two verbal communications, or
  - If a crewmember does not respond to a verbal communication associated with a significant deviation from a standard flight profile
- If you don't feel well, say so and let the other pilot fly
- Other symptoms of the beginning of incapacitation are:
  - Incoherent speech
  - Strange behavior
  - Irregular breathing
  - Pale fixed facial expression
  - Jerky motions that are either delayed or too rapid

Actions in Case of Inflight Pilot Incapacitation

The remaining pilot must assume or maintain control

Establish a safe flight profile and engage the autopilot; use all possible automation

Obtain cabin crew assistance

Restrain the incapacitated crew member so that he cannot interfere with essential controls or switches by fitting and locking full shoulder harness, sliding the seat fully aft and locking partly reclined

Declare an emergency and inform ATC

A partially incapacitated pilot should not be allowed to participate in the subsequent operation of the aircraft, as judgment may be impaired

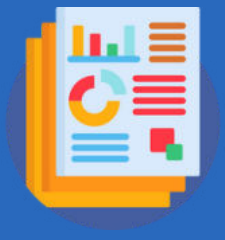
Initiate diversion

Complete the approach and landing using the autopilot as much as possible

Arrange medical assistance upon arrival

After landing, seek immediate medical assistance

Occurrence Reporting Procedure



The PIC will report the incident to Chief of Flight Safety and Flight Operations. The Chief of Flight Safety is responsible to report it by quickest means within 24 Hours to AAIB and DGCA.

Final Words

Pilot incapacitation remains a critical concern in aviation safety. Airlines and regulatory bodies must continuously prioritize stringent protocols, comprehensive medical evaluations, and crew training to minimize risks. Vigilance and preparedness are essential to handle these emergencies effectively and ensure the safety of passengers and crew on board. In flight crew, the early detection of any underlying pathology, as well as the management of what might be considered a 'benign event' in many cases in the general population, is crucial for flight safety.

About the Author

Sanjay Bhargava is a consultant Aerospace medicine specialist and renowned Class 1 medical examiner impaneled with DGCA. He is an alumnus of Armed Forces Medical College Pune. After completing his post-graduate in Aerospace medicine at the Institute of Aerospace medicine Bangalore, Dr. Sanjay worked as a specialist in Aerospace medicine with the Indian Air Force. He is a DGCA Class 1 examiner with extensive experience at AFCME, Delhi, AFS Tambaram, and served as President of MEC (EAST), Jorhat. He has been responsible for finalizing various policies at DGCA. He was the lead doctor for starting civil medical centers for class 1 medicals for DGCA. Over a while, he has assisted aspiring pilots and solved their DGCA-related medical issues through his website http://dgcamedical.in. He has a large following on social media and is respected for his advice given to pilots for the last 3 decades. Dr. Sanjay can be reached at:
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Understand Your

Aircraft Oxygen System

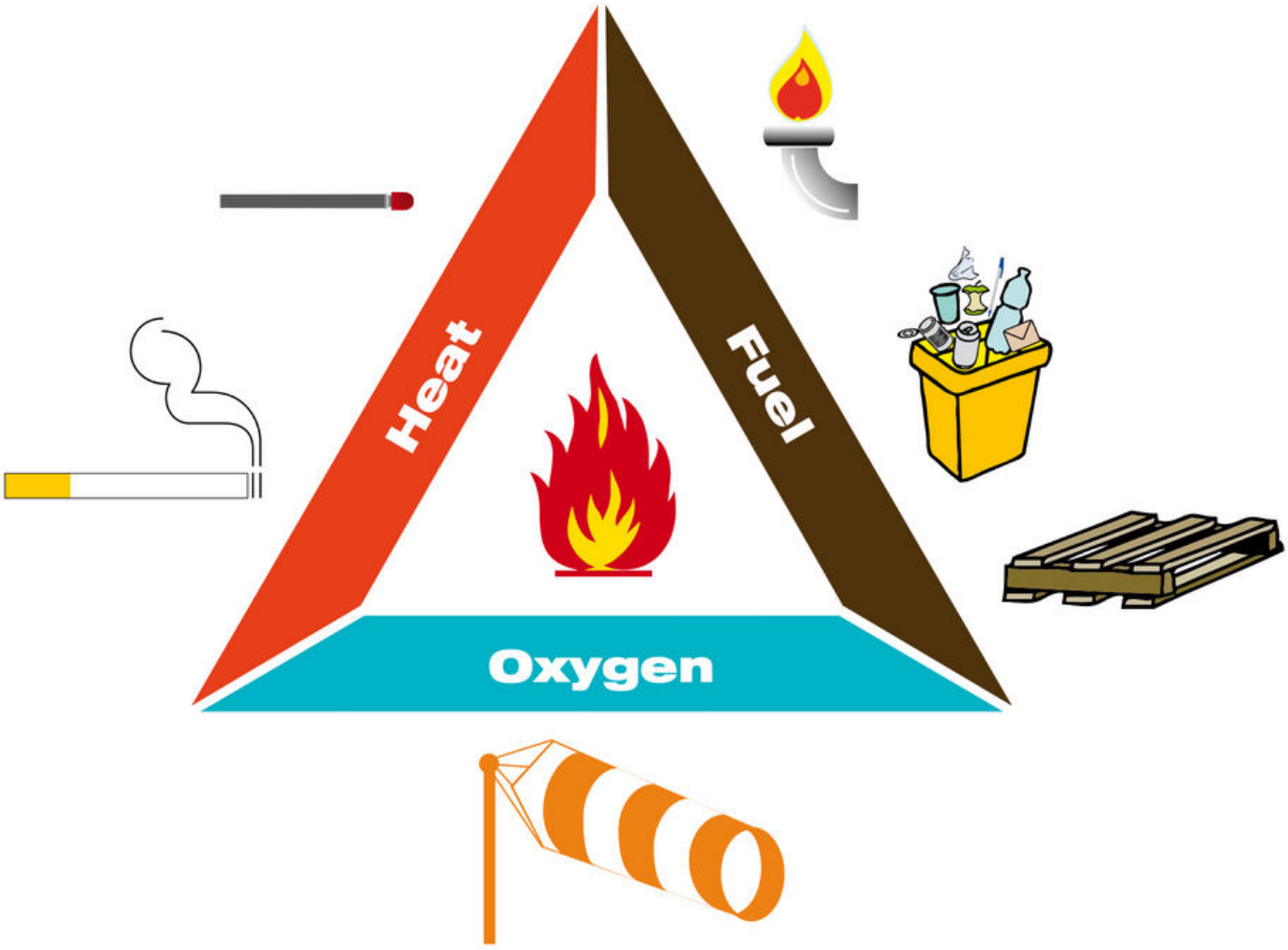
Abhishek Nayyar
Correspondent
100 Knots

Oxygen and Fire

Oxygen (O2) is vital for most forms of life on earth. O2 is naturally present in the air we breathe at a concentration of approx. 21%, the rest is mainly nitrogen. But the benign gas we breathe has the potential to become lethal in concentrated form. Each year, workers are harmed and killed by high-energy-yielding reactions resulting from inappropriate handling and cleaning of oxygen components.

One of the characteristics of oxygen is that it is an oxidant. In fact it is the most common oxidizing agent, hence the name. Fires in oxygen enriched environments are characterized by higher intensities and temperatures and by a more rapid combustion than their equivalents in normal environments. The higher the concentration of oxygen, the more explosive the result. Materials which will not ignite at normal oxygen concentration levels, may burn in an oxygen enriched environment. Fire and explosion hazards may develop, even at ambient temperature and in the absence of sparks, when O2 at high concentration levels is set in contact with commonly found materials such as hydrocarbons, oil and grease.

A basic knowledge of oxygen equipment can be critical whether you are flying a commercial, commuter, or a general aviation aircraft. This equipment is the first line of defence against the potentially lethal effects of hypoxia and carbon monoxide poisoning. It is the responsibility of the pilot that all aboard the aircraft, crew-members and passengers, know how to use this life-saving equipment safely and efficiently.



Why Suplemental Oxygen?

The human body is dependent on oxygen. As the altitude increases, the consequent decrease in pressure reduces the amount of oxygen the human body can absorb when breathing. To enable flight at high altitudes either the aircraft cabin has to be pressurised, to replicate the pressure at a lower altitude. At the cruising levels commonly flown by commercial air transport aircraft, loss of pressurisation can quickly lead to incapacitation. The higher the altitude, the lower the Time of Useful Consciousness (TUC), the duration an individual can stay conscious and capable of taking corrective actions in case of sudden cabin pressure loss. As altitude increases, TUC decreases, leaving passengers and crew with limited time to respond to emergencies. (Skybrary)

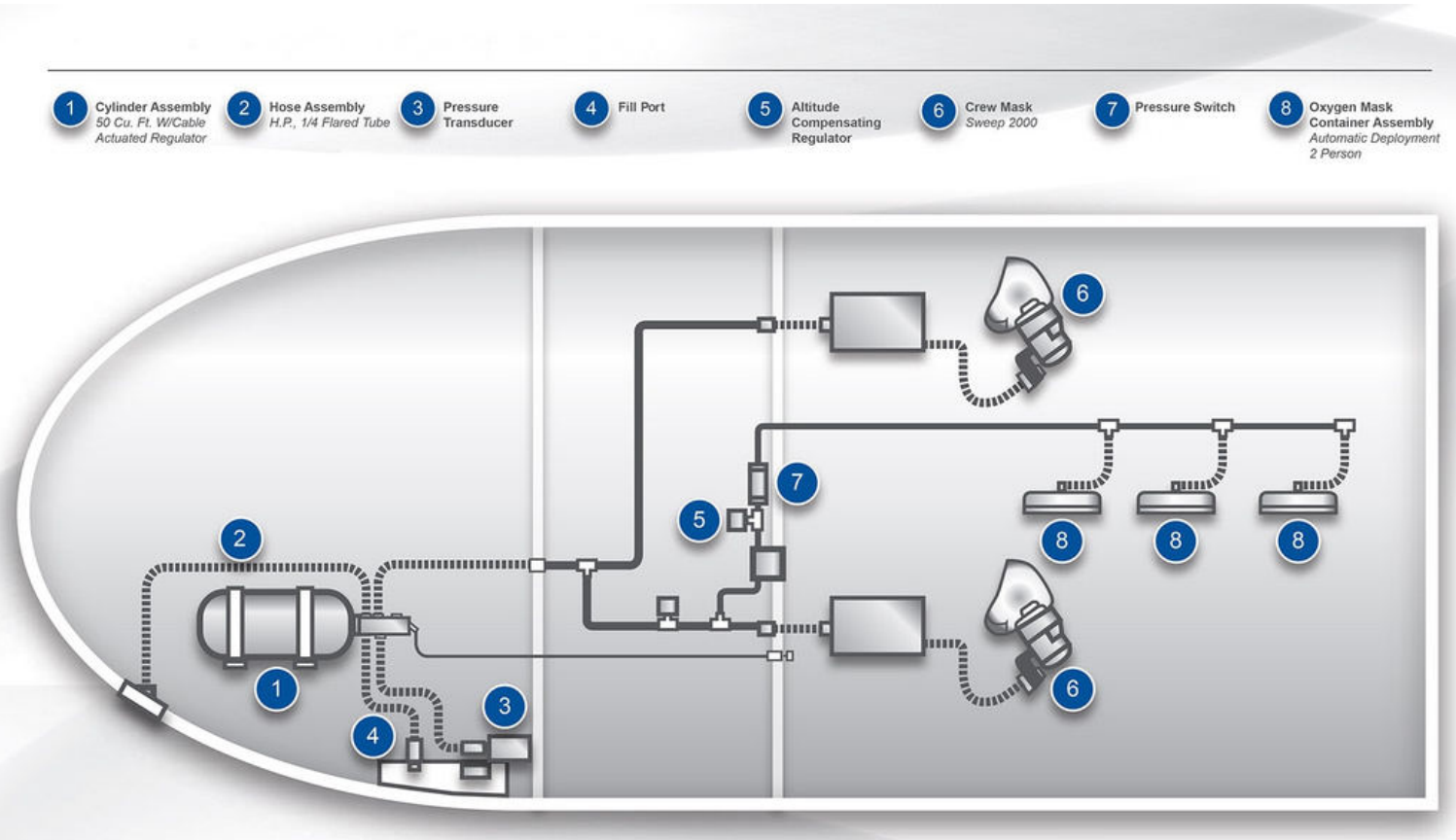
Time of Useful Consciousness

Altitude (feet)	Flight Level	Pressure (hpa)	Temperature (C) (ISA)	Consciousness
15,000	150	571.8	-14.7	30 minutes or more
18,000	180			20-30 minutes
22,000	220			5-10 minutes
25,000	250	376.0	-34.5	3-5 minutes
28,000	280			2.5-3 minutes
30,000	300	300.9	-44.4	1-3 minutes
35,000	350	238.4	-54.2	30-60 seconds
40,000	400	147.5	-56.5	15-20 seconds
45,000	450			9-15 seconds
50,000	500			6-9 seconds

An aeroplane intended to be operated at altitudes at which the atmospheric pressure is less than 700 hPa (10000 Feet) shall be provided with oxygen storage and dispensing apparatus capable of storing and dispensing the oxygen. (DGCA)

Egypt Air Flight 667

Date: July 29, 2011
Incident: Oxygen-fed fire in the flight deck of an Egypt Air Boeing 777-200 ready to depart from Cairo. Passengers: 317
Evacuation: All passengers successfully evacuated through air bridge access to doors 1L and 2L.
Damage: Flight deck and surrounding structure suffered significant damage.
Cause: The investigation could not determine the exact origin but speculated that wire damage from inadequately secured cabling might have ignited an oxygen leak from the crew emergency supply.

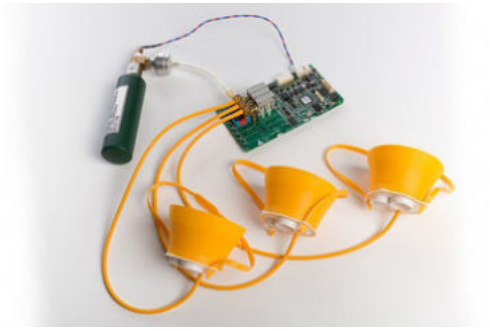


Aircraft Supplemental Oxygen Systems

Commercial jets use chemical oxygen generators to generate oxygen. These devices contain chemicals that release oxygen when activated. Cabin pressure drop triggers a firing pin, initiating a chemical reaction to produce oxygen. Oxygen generated by chemical generators is stored in cylinders or reservoirs on the aircraft. Cylinders are strategically placed throughout the plane for easy access to oxygen. Ensures quick availability of oxygen for passengers and crew members.

Oxygen masks are automatically deployed when cabin pressure drops significantly. Allows passengers and crew to quickly don masks and receive oxygen. Masks remain in place until the aircraft reaches a safe altitude or the emergency is resolved. Flight attendants conduct safety briefings before take-off with instructions on how to use oxygen masks during emergencies are provided.

Oxygen is present in modern aircraft in the following four systems:



Passenger Oxygen Masks

Overhead oxygen masks are available for each passenger seat that automatically drop down when there is a significant drop in cabin pressure. They are connected to a central oxygen supply system on the aircraft and intended to provide a sufficient supply of oxygen to passengers during emergencies. They are supplied by either O2 chemical generators or O2 gaseous cylinders.

Portable Oxygen System

Set of first aid oxygen bottles for therapeutic use.

Portable Oxygen System

These are special masks with oxygen generators designed to provide crew with a breathable atmosphere in the event of smoke or fire on board.

Cockpit Oxygen Masks

The flight deck (cockpit) is equipped with oxygen masks for the flight crew. These masks serve the same purpose as passenger masks, ensuring an adequate oxygen supply for the pilots in case of emergencies that may result in a loss of cabin pressure. The flight crew O2 system, which is supplied by one (optionally two to four) cylinders.

Safety Precautions

Flight and Cabin Crew

The pilot should complete the "PRICE" check on the oxygen equipment before each flight. The acronym PRICE is a checklist memory aid for pilots and crewmembers while inspecting oxygen equipment.

Pressure

Ascertain that there is sufficient oxygen pressure and quantity to finish the journey.

Regulator

Check the oxygen regulator for proper operation. If you are utilizing a continuous-flow system, ensure that the outlet assembly and plug-in coupling are compatible.

Indicator

Flow indicators are used by most oxygen delivery systems to indicate oxygen flow. Flow indications can be either on the regulator itself or within the oxygen delivery tube. To guarantee a continuous supply of oxygen, don the mask and check the flow indicator.

Connections

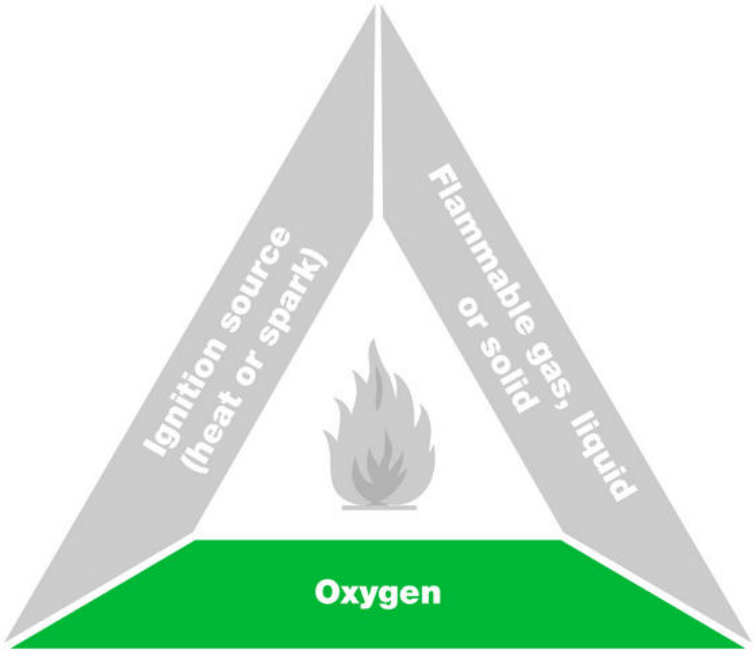
Make certain that all connections are secure. The oxygen lines, plug-in coupling, and mask are all included.

Emergency

Have oxygen equipment on hand aboard the aircraft in case of an oxygen emergency (hypoxia, smoke and fumes, rapid decompression/decompression sickness). This phase should involve briefing passengers on the location of oxygen and its proper use.

Maintenance Precautions

Prevent an oxygen enriched atmosphere
When the aircraft is on the ground, the confined areas containing the oxygen cylinders and distribution lines are not ventilated anymore, and oxygen leaks will lead to hazardous enriched oxygen environments.

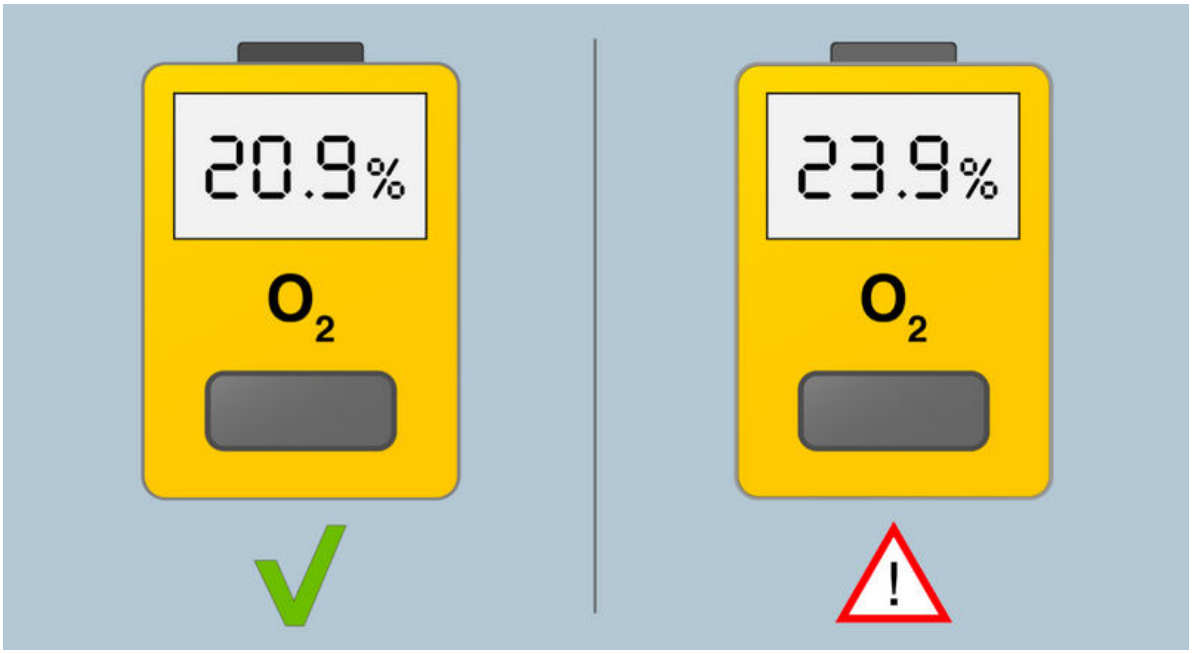


Avoid ignition sources
When working on oxygen systems, whether during oxygen servicing or oxygen components removal and installation, beware of potential ignition sources.

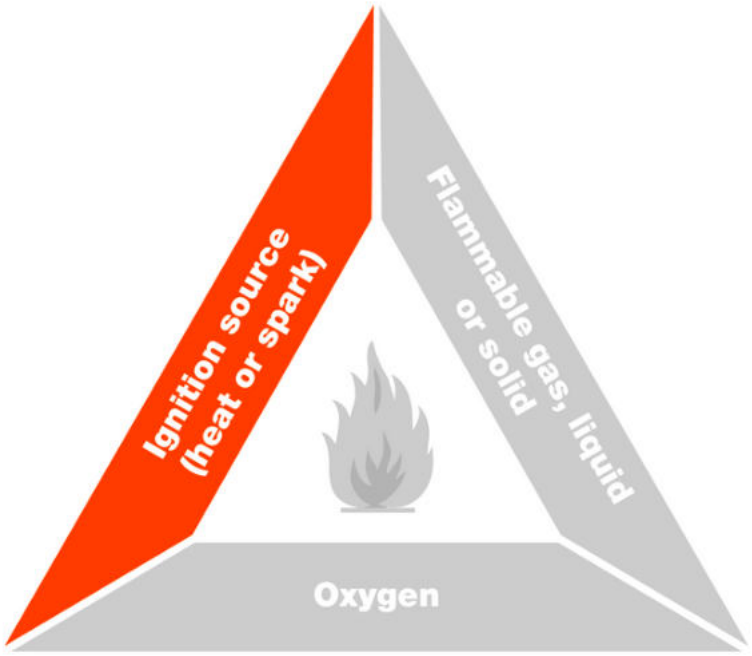
Follow maintenance procedures and instructions of use
To prevent any oxygen leak during servicing, It is also crucial to follow the operating instructions.

Keep track of your oxygen servicing
It is recommended to keep track of the frequency of the oxygen servicing especially if it often occurs before the scheduled maintenance as this could indicate a leak in the oxygen system.

Use an oxygen detector and ventilate confined areas
Any oxygen leak can create an oxygen-enriched environment. During flight, these areas are ventilated by the aircraft air conditioning system. However, when on the ground there is no ventilation. Therefore, maintenance crews should be aware of the oxygen level before entering those confined areas



Prevent any Ignition Source



Prevent heat coming from sparks or flames

It is forbidden to smoke during oxygen servicing. Oxygen servicing must not be performed in the proximity of other maintenance activities that could create flames, heat, or sparks such as grinding or drilling.

Prevent heat coming from electrical discharge or electrical overheating

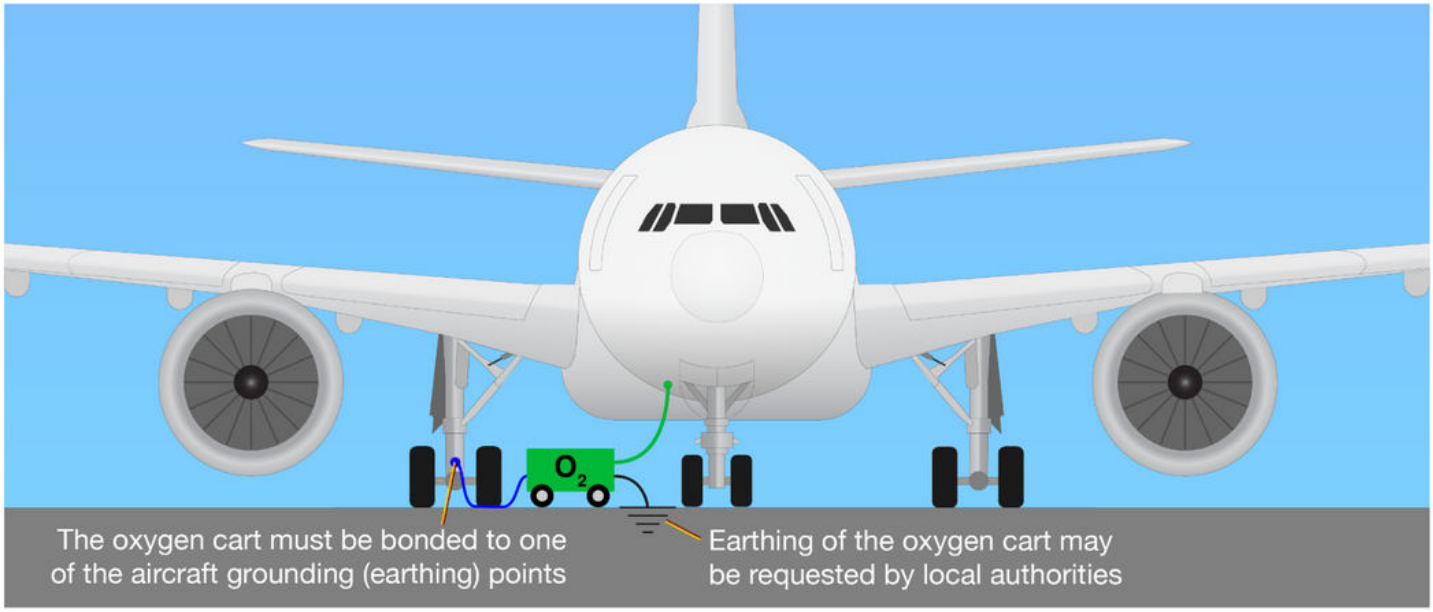
It is forbidden to use mobile phones during servicing and to perform oxygen servicing during thunderstorms. When refilling oxygen, it is mandatory to bond the aircraft to the oxygen servicing cart before connecting the refill valve. This will ensure electrical continuity between the aircraft and the oxygen servicing cart and prevent the likelihood of sparks due to a potential difference between the aircraft and the cart.

Prevent rapid oxygen pressure build-up

Handle oxygen valves with care to prevent rapid oxygen pressure build-up and ignition of flammable materials. Also, if dust or debris are present in the system, for example, due to contaminated tooling, a fast oxygen flow could create sparks as a result of particle impact.

Respect a safety zone

As an industry standard, a 5-meter safety zone must be maintained around the oxygen filling port during refilling.

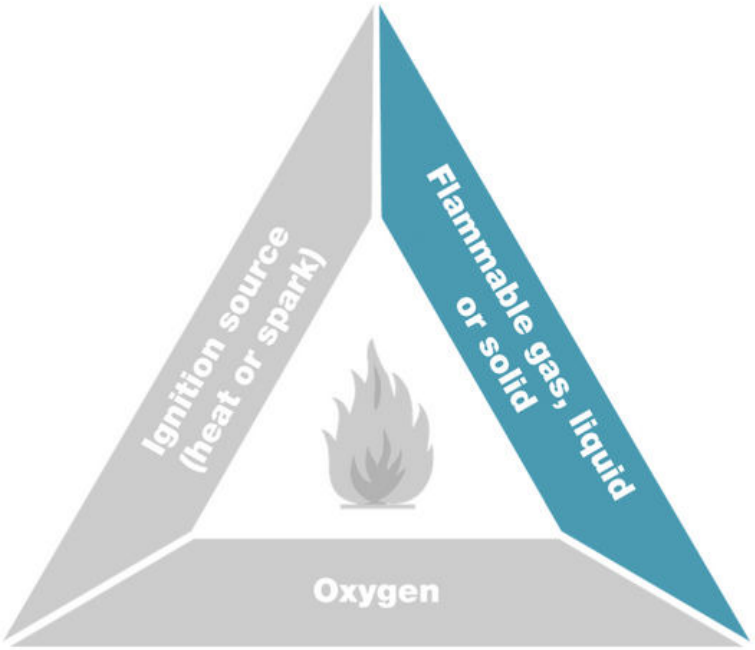


Prevent Presence of Flammable Gas, Liquid or Solid

Restrict other maintenance activities
Oxygen servicing must not be performed during refueling, cleaning, deicing, when working on fuel and hydraulics, or any systems using flammable materials. Oil, grease, lubricant, fuel, cleaning and deicing materials are flammable and can self-ignite the presence of concentrated levels of oxygen.

Only use approved lubricant/cleaner
The maintenance crew should only use approved lubricant and cleaner products on oxygen system components.

The importance of a clean work area, tools and servicing equipment
A clean work area, tools and servicing equipment should be ensured to prevent dust or debris entering into the oxygen system. Check that each person working on the oxygen systems, or performing oxygen servicing tasks, has clean hands, clean clothes, clean tools, and clean working areas. This will avoid oil or grease stains from coming into contact with oxygen gas. This will also avoid the presence of particles or other contaminants that could lead to a fire if combined with a heat source and oxygen.



Conclusion

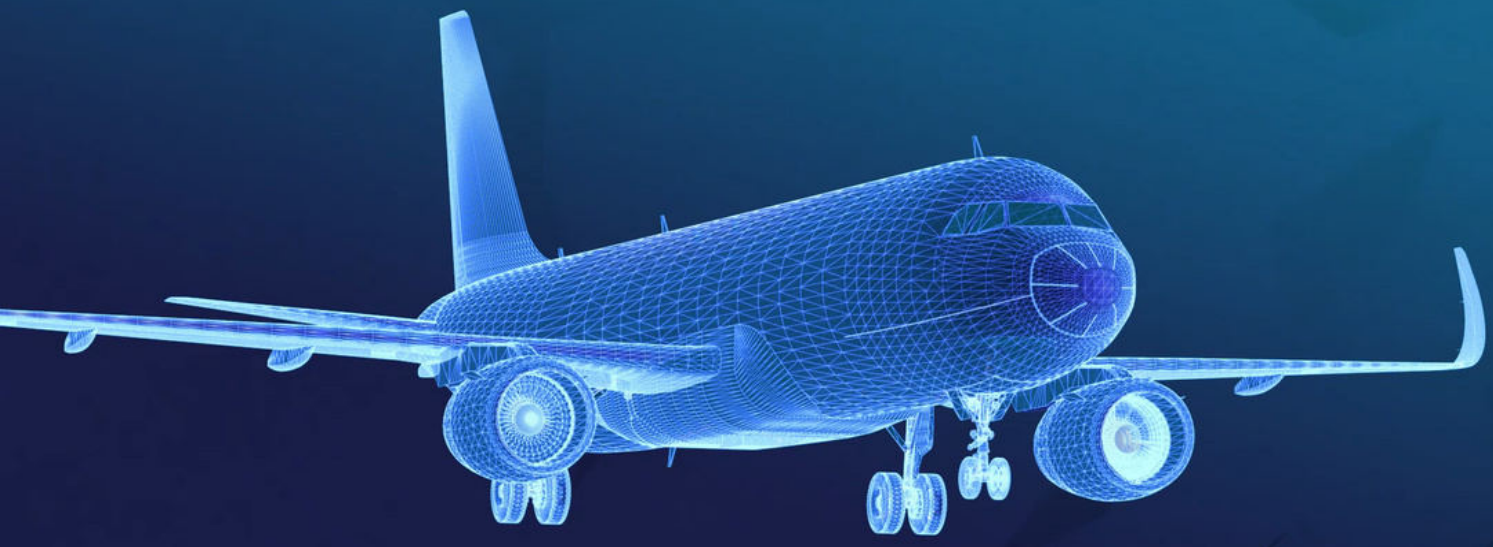
To summarize, remember that higher concentrations of oxygen are dangerous and represent a risk of fire and explosion, especially when the aircraft is not flying. As a general rule, when working on oxygen systems, use only equipment approved for oxygen use, keep it clean and work carefully and safely by following the correct procedures, as specified in the manufacturer documentation.

Growth of

Commercial Aviation MROs

in India

Cdr Amogh Warhadpande (Retd)
Former Chief Learning and Development Officer
Air Works Group



Abstract

All indicators point to high growth rates for aviation and aviation related businesses in India for the next few decades. As the fleet inventories grow, new airlines enter the field, and new airports are developed to support the vision of UDAN, the aviation growth will be sustainable only if we ensure profitability for indigenous Maintenance Repair and Overhaul (MRO) Industry and a sizeable proportion of the Maintenance is done by home grown MROs. However, the MRO Industry in India faces challenges which prevent it from being competitive, thus resulting in maximum revenue from Maintenance going into coffers abroad. As far as our planning for the future goes, lack of vision and coherent policies have meant that we are way behind Singapore, Malaysia, Philippines and even possibly Thailand and Sri Lanka. Radical changes are thus needed in Policy and Execution to enable India to emerge as a MRO leader in APAC.

Introduction

Aviation and Aviation Manufacturing sectors will employ more than 25 million by 2040 (including direct, indirect and induced employement)[1]. It is clear therefore that a robust airline industry is critical for a robust economy[2] and to enhance economic growth, India must become a key aerospace destination. This would need initiatives to promote aviation in Civil / Military sector and provisions for incentives for Investment, Tax reforms and assistance for building Infrastructure for MRO [3,4]. India will be the 3rd largest aviation market by 2024[5] and India's fleet size and MRO industry will grow by 8% and 12% respectively. This is larger than APAC's 2.5% and 1.8% and China's 5.2% and 6.9 % growth figures for fleet size and MROs[6] (Fig 1). Increasing Fleet size and Flying hours will mean increased MRO business only if home grown MRO industry is supported. This will make Aviation growth in India affordable and sustainable, otherwise, the Business, Manpower and the associated Economic Benefits will vanish into coffers abroad.

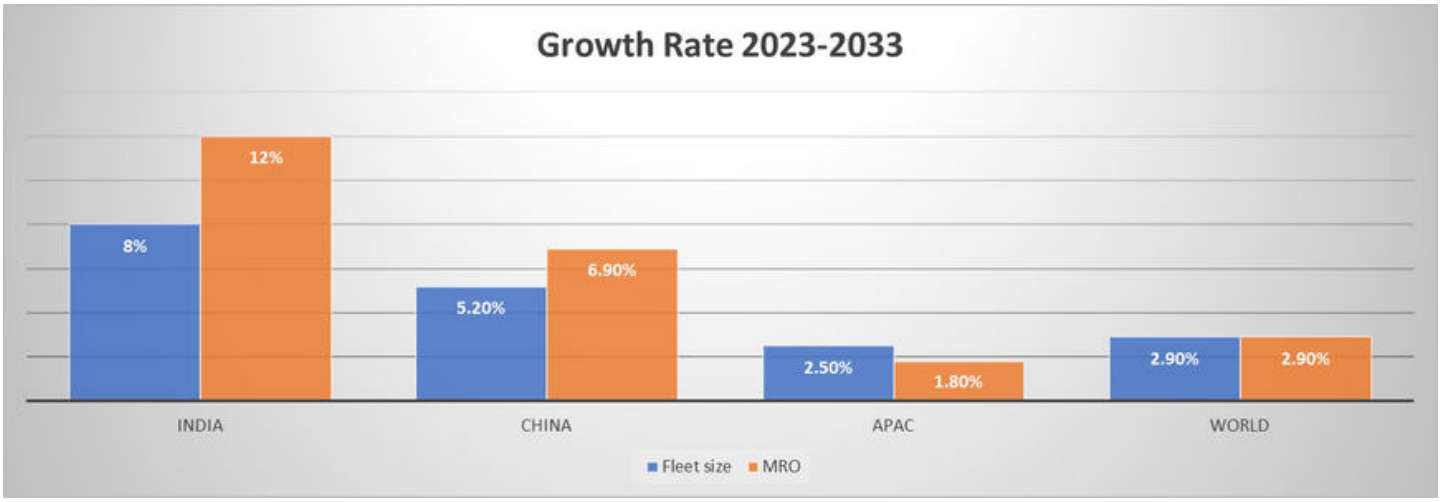


Figure 1

Challenges - MRO Survival and Growth

The factors affecting survival of MROs in India are discussed in the suceeding paragraphs.

Entry Barriers

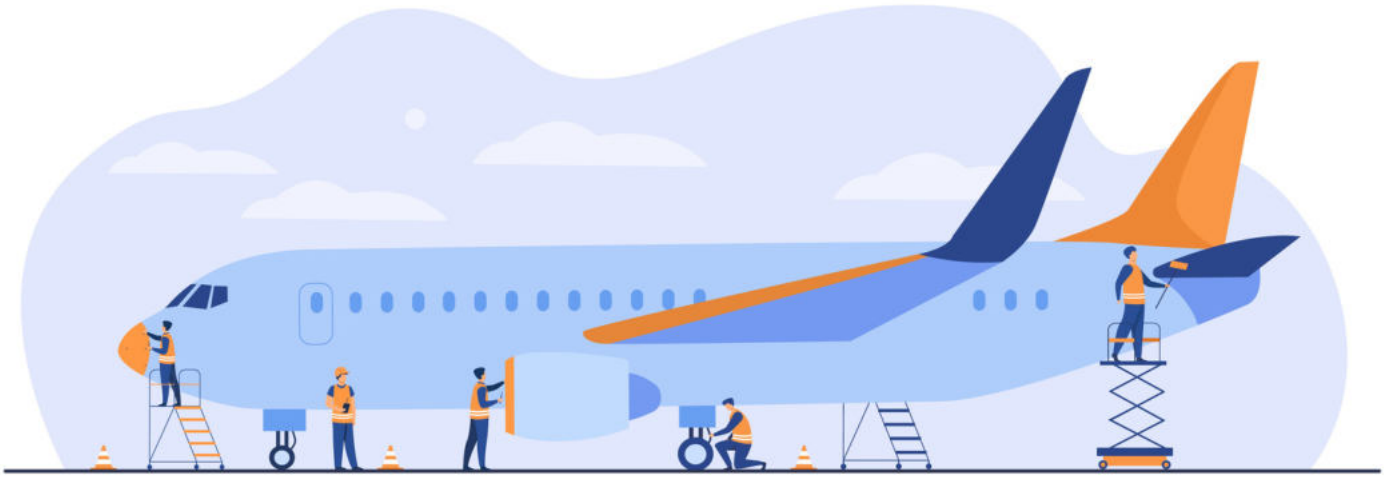
Establishing an MRO needs Regulatory Approvals. Obtaining and sustaining these approvals involves considerable expense. Additionally, there is expenditure involved in infrastructure (Hangars, Tooling, GSE, Test Equipment, Structural Repair Shops, Painting facilities, Battery and Heat Exchanger Shops, Stores, NDT facility), employment of qualified manpower, maintaining their endorsements and approvals, obtaining regulatory approval from customer's regulatory bodies (in case customer is operating aircraft licensed abroad), employment of support function verticals etc. This is a rather high initial and recurrent expenditure. The necessity to maintain several approvals and exhaustive compliance requirements makes it extremely difficult not only for new entrants, but also for the existing players to survive in this industry.

Acceptability - Indian Standards

Federal Aviation Administration (FAA) and European Aviation Safety Agency (EASA) are accepted in India by DGCA. However, lack of acceptance of DGCA credentials by American/European aircraft lessors, airlines and owners necessitates maintenance of most of these aircraft abroad, losing revenue for India.[5] The alternative is for Indian MROs to acquire and maintain FAA / EASA accreditations and approvals which burdens them with additional cost and affects their competitive pricing.

Shylock's Pound of Flesh

OEMs deny data availability to independent MROS in the after – market. This restricts the Indian MROs ability to diversify and expand their services. OEM affiliated MROs get the benefit of "below list pricing" under long term contracts. Independent MROs deal with higher than list pricing impacting their competitiveness. OEMs monopolise after-market availability of repaired and serviceable spares, necessitating operators and MROs to deal with OEMs. OEMs provide heavy discounts on engines and components but impose contract conditionalities on Power By the Hour (PBH) and after – market services in their designated MRO shops, mostly abroad, thus taking the actual contract revenue overseas. Further, Offset clauses rarely get implemented restricting Training and Technological capacity limiting Operations and Expansion.[5]

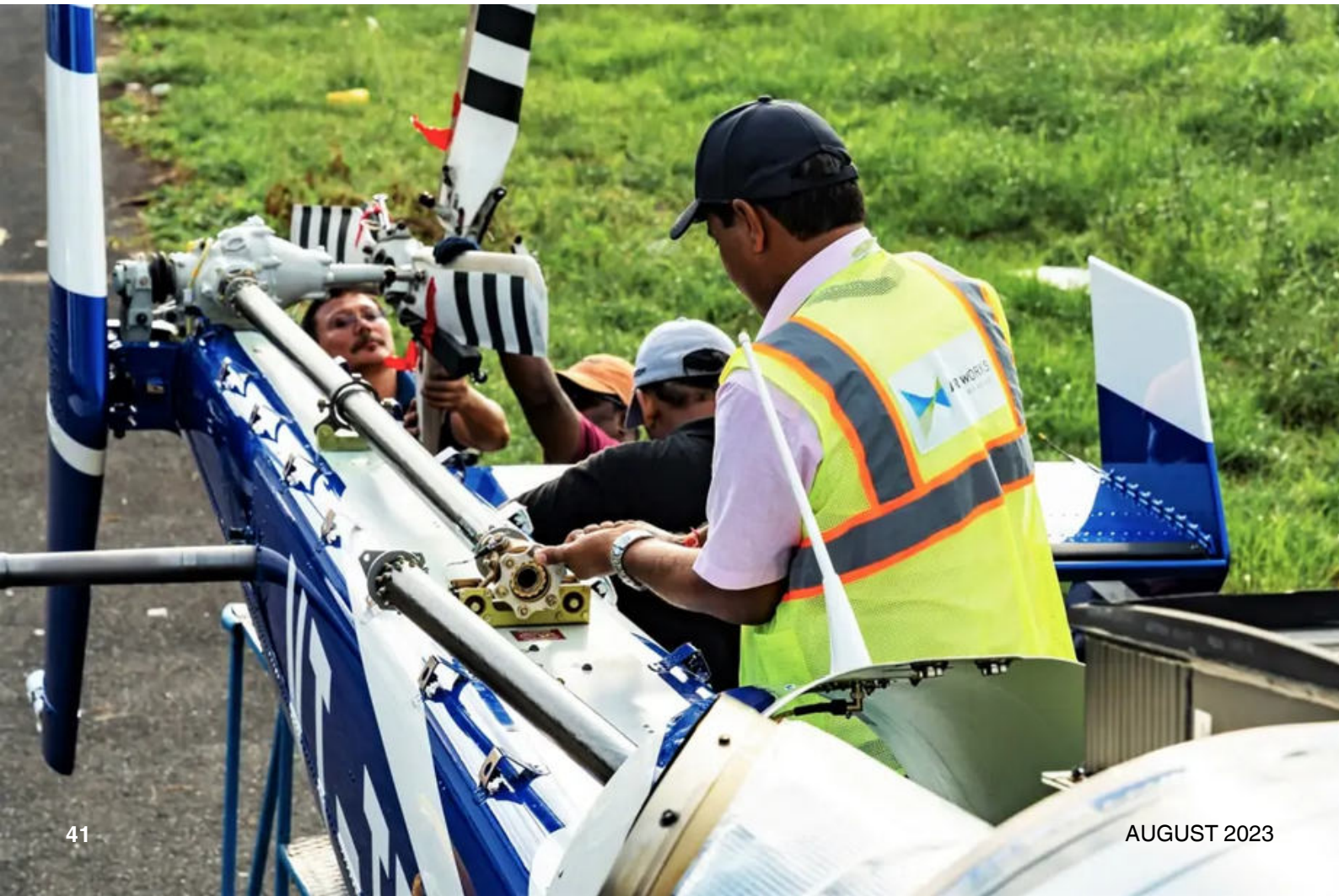


Lack of Policy/Infrastructure Support

It is ideal to have MROs within or near the airport premises to cut down logistics costs and streamline MRO operations.[6] Lack of provisioning of land for MROs within major airports compels them to incur additional Infrastructure, Logistics and Operational costs. The taxation / duty structure on spares and components and royalties charged by Airports for utilizing services provided negatively impact competitive pricing for Indian MROs. These overheads result in poor profit margins. Despite seven decades in the Industry, Indian MROs have negligible share in the two biggest MRO activities, Engine Maintenance and Component Repairs which are 40% and 21% of the MRO market respectively.[7]

Lack of Competent Technical Workforce

In the glamorous world of aviation where pilots and cabin crew hog the limelight, the MRO industry operates behind what appears to be an Iron Curtain and fails to attract the attention of high quality job seekers. It rarely finds a mention in top level policy documents. The Vision document 2040 for Civil Aviation in Industry in India (2019), running to 130 pages, devotes only one superficial paragraph lamenting the quality of AMEs in India whilst devoting four pages for pilot training. Maintenance is a major cost item accounting for about 12-15% of airline Revenue.[7] Qualified Technical manpower will be critical to sustain aviation growth in India's bid to be counted amongst the top economies. Technical Workforce requirements for MROs in the period 2015-2035 will see an increase of 25X [1] for India, so issues pertaining to civil aviation technical workforce need to be addressed on priority. High Entry Barriers, Lack of opportunities for Career Growth / Compensation, Industry Demand/ Supply dynamics, the constant Technology Shift and resulting Employability Gap and inability of MROs to pay attractive salaries in comparison to Airlines and competitors abroad are some of the ailments afflicting the MRO industry in this matter.



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Remedies – MRO Survival and Growth

The following remedies may be considered to ensure India's march towards building a powerful presence in aviation: -

Process Improvements to Overcome System Inefficiencies

MRO industry needs to shed process inefficiencies to improve the poor profitability despite a significant increase in aircraft undergoing maintenance checks and Redeliveries. Rising costs of oil and shortage of supply will increase maintenance costs as will skilled labour shortage. [2] Imminent Technology shifts in Manufacturing / Maintenance will change Maintenance Strategy from Reactive / Preventive to Predictive / Prescriptive. 95% accuracy in the predictions is easily possible with collaborative efforts between data scientists and maintainers supported by OEM Fleet Knowledge. Migrating from Reactive to Predictive Maintenance philosophies can bring in significant cost savings by providing buffer time to effectively plan maintenance activities as they give advance notice of failures and actions needed without disrupting operations.

As analytics evolves and refines, Predictive and Prescriptive maintenance will ensure that the aircraft will enter service with a higher degree of reliability and availability. This will entail corresponding changes in Training requirements and abilities of the maintenance personnel of the future. MROs need to incorporate tools like Lean, Six Sigma, Block Chain Artificial Intelligence and Machine Learning for Waste Reduction, Process / Efficiency Improvement, Transparency, Security, Traceability, Scrutiny and Tamper Proofing of processes and achieving Bottom-Line gains through Prescriptive and Predictive Maintenance.

AI and ML will continue to be ubiquitous in Predictive Maintenance. The extensive use of drones in Maintenance activities is already a reality. These changes will have the desired outcome of maximising Revenue Passenger Kilometers (RPK) and extracting maximum value and benefit from Analytics. However, this would need expert engineering knowledge in aircraft systems to work in conjunction with Data Science and Advanced Analytics. Use of Mathematics in ML and Deep Learning methods to find meaningful predictive signatures and patterns that are invisible to naked eye can be identified and several costly and time consuming inspections can be avoided. [8]

Remedies – MRO Survival and Growth

Need to Revitalise MRO Industry

India's Civil Aviation Industry, Consumer Demand, and Fleet size are all increasing. Favourable Policy Interventions, Potential Redelivery Maintenance Contracts and Labour Arbitrage make a strong case for building MRO growth strategies in India. The obvious benefits will be a reduced FOREX outflow, greater employment opportunities and benefits reaching airlines and consequently to consumers. By 2031, the size of MRO industry is likely to grow almost by 230% (from USD 1.7 to 4.0 Billion).[5] (Fig2) The global growth for the same period is only about one third at 70%.

The projected CAGR for India is much higher as compared to the global average and that of APAC.[6] The major growth in the engine MRO segment is evident in terms of JVs between AIESL and Pratt &Whitney, Safran and L&T, and Wadia Group and SIA Engineering[4, 5] . India will see the largest jump in fleet size by 2033 at 113% as compared to world's average 55% , APAC's 68% and China's 61[5]. (Figure 3) To revitalise Indian MRO segment, we must study interventions by Governments for MRO hubs in the APAC region. Significant tax benefits make leading MROs in APAC attractive markets.

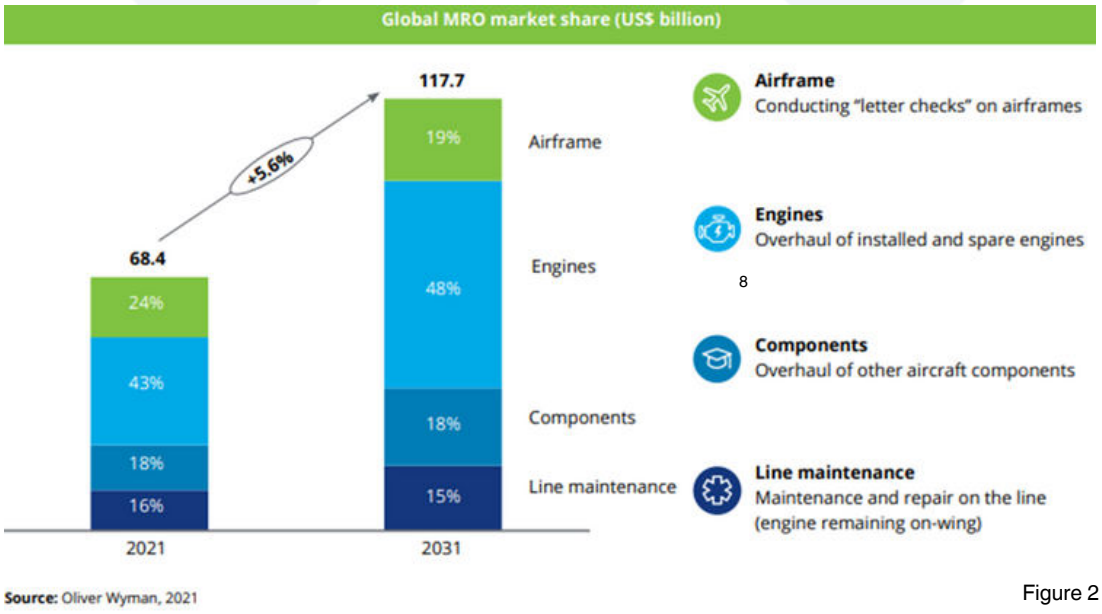

Figure 2

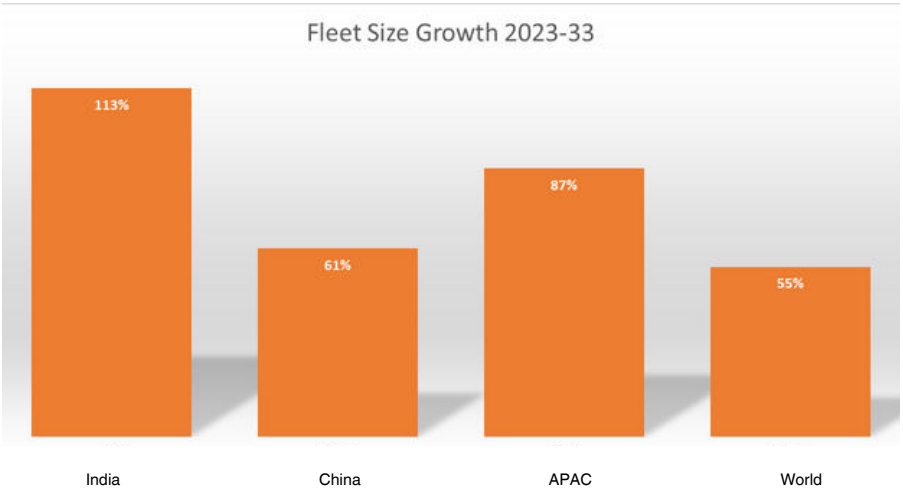

Figure 3

Singapore is home to 25% of Asia's MRO market and has changed the focus from labour abritrage to driving value through logistics and supply chain availability by focussing on JVs/ Strategic Partnerships of global companies with indigenous enterprises and usage of drones/data analytics for inspections. They have focussed on building an efficient homegrown workforce with governmental support in initiatives for skill development and bridging the skilling gap to produce high quality work. Singapore has ensured avoiding regulatory duplications by getting EASA and CAAS to mutually recognise certifications in July 2017. In addition to building up strength within the country, Singapore has established its presence abroad as well with SIA Engineering Company establishing a total of 23 subsidiaries and JVs in seven countries with strategic partners like Rolls Royce, Pratt and Whitney, GE, Safran and Collins. Lufthansa Technic, by a similar strategy, has its presence in all MRO activities, across the globe with a stake in 53 companies. [3]

Malaysia, the second largest MRO in Southeast Asia has also promoted Public Private Partnerships, Technology Acquisition for Indigenous Businesses, R&D and conformity with International Standards Proceeding in a progressive manner since the launch of their National Aerospace Blueprit in 1997, Malaysia has now launched the Aerospace Industry Blueprint 2030 during the Langkawi International Maritime and Aerospace Exhibition (LIMA) towards becoming a leading aersopace nation in Southeast Asia and an integral player of the global market with a target to capture 50% of Southeast Asia MRO business and 5% of the Global market by 2030. The Malaysia Industry Government Group for High Technology (MIGHT) was founded in mid 1990s to bring Industry, Government and Academia stakeholders together with a consortium of 11 Public Institutions to resolve Human Resource aerospace industry needs by development of education and Training Programs which are aligned with Industry improvement strategies. Malaysia has been able to challenge Singapore by evolving through cohesive policies and continuous government support. Thailand, with its growth in Tourism and Logistics industries and thrust on skill development, is a strategic location for the aviation MRO industry and has plans to leverage its strength in automotive parts and petrochemical supply chain to develop aviation components industry. [5]

Civil – Defence MRO Convergence – Infrastructure / Asset Utilisation

Maintenance, Spares, Components and Training Requirements in civil and defense sectors are nowadays similar, especially with the Defence inventory growing in terms of assets similar to those in Civil Aviation due to contributions from mainstream OEMs like Airbus, Lockheed Martin and Boeing. The PPP model for Civil and Defence MRO convergence strategies needs to be implemented. Veterans, armed with decades of aviation experience, often end up in BFSI, Facility Management, Teaching and Infrastructure Security roles. They can be made industry ready much quicker than a new Technician / AME. We can thus enable a sharing of Infrastructure, Resources and experienced / motivated manpower whilst tapping into a rich vein for business within the country.

Providing Quality Manpower [1]

Training Reforms would be required to equip the MRO industry with a competent workforce seeing the diverse set of skills and upskilling requirements to be fulfilled. The need for a Unified Common Policy and Standards, convergence of thought and effort between NSDC and DGCA and a one stop solution for all Aviation related Training is paramount.

We would need an apex National Civil Aviation Training Entity functioning under the aegis of a National Aviation University and having a unified view of Training and Skill building. The imminent paradigm shifts in Technology demand the need for forging International Collaborations to increase acceptance of Indian Regulatory bodies worldwide. Bridging the Industry, Academia and Regulatory Gap, employing International best practices and an increased Industry Role in Infrastructure for Upskilling, Transparency, Standardisation and Regulatory compliance is a need of the hour.

Retention Strategies

There is a high rate of attrition especially amongst the skilled technical workforce in the MRO industry due to movement of AMEs and Technicians between Airlines, MROs and OEMs in search of better opportunities. Advent of new airlines or collapse of existing ones makes the situation volatile. Retention Strategies need to focus on creating a pool of loyal and motivated employees. This can be achieved by the career aspirants being given a clear visibility of the path ahead and providing deserving candidates with the opportunities to achieve their career goals.

Conclusion

2020 and 2021 saw the largest global airline losses of $137bn and $51bn respectively. Widescale airline failures were prevented by Government support exceeding $240bn. The only reason such support was extended is the strategic importance of air travel from a commercial and social perspective [2]. The Civil Aviation well being in any region is inexorably linked to growth of MROs in that region. The projected growth of Civil Aviation in India and in APAC will be an affordable reality only if MROs in the region survive, sustain and grow and make a contribution to the economy. Volatility of oil prices in the present geo political situation make accelerated Technology changes imminent.

Capital expenditures to provide infrastructure for MROs to cope with changing technology will be needed to maintain their relevance. With the profitability margines of airframe MROs likely to dwindle more with the advent of predictive and prescriptive maintenance philosophies, the only way out is to diversify and build up engine and component MRO capability to augment existing functions.

This becomes all the more important seeing that the Current Engine Option (CEO) for both Boeing and Airbus will be forced into an early retirement by the New Engine Option (NEO) (Fig 4).

India will soon have 2.5X times the number of engines it has presently (with 1.5X of the present engine inventory being on order). Alternate propuslion systems are already looming large on the horizon. Capacity building in terms of skilled manpower alone will not be enough unless policy changes to compete with Singapore, Malaysia, Thailand and Philippines are implemented to give the Indian MRO industry the werewithal to hold its own in APAC. To put this in perspective, consider the US MRO industry. The US has a home grown aircraft manufacturing industry, a massive defence manufacturing and MRO industry, faces no challenges in terms of acceptability of FAA in the world and has the weight of the government behind it, and yet has projected CAGR predictions of only 4% [9] for the next decade. Imagine then the road ahead for Indian MROs with a mountain of internal and external challenges that need to be overcome.

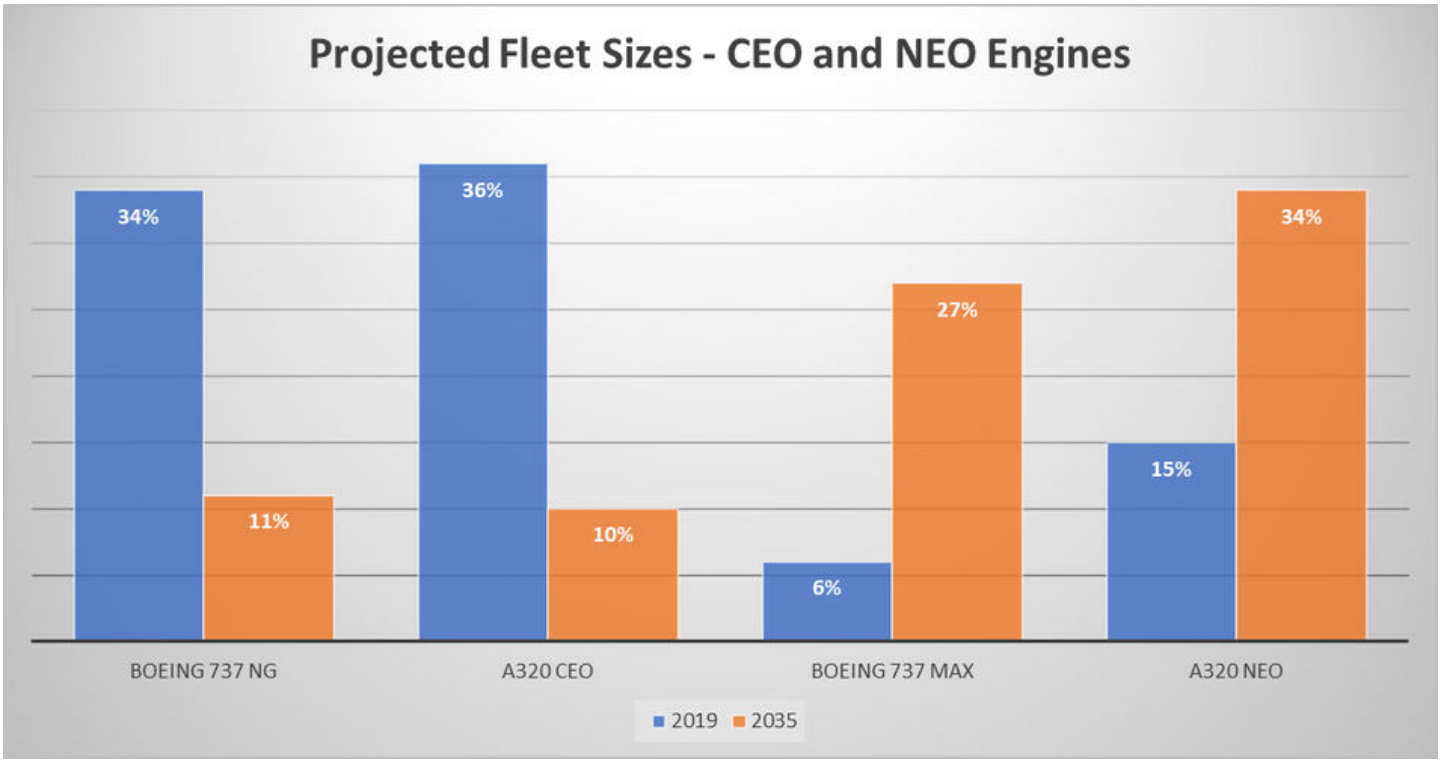

Figure 4

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Cdr Amogh Warhadpande (Retd) served in the Indian Navy for 24+years as a Naval Aviation specialist. He is an alumnus of the National Defence Academy, Pune, Naval Engineering College (B Tech), Indian Institute of Technology Madras (MTech, Controls and Instrumentation) and Faculty of Management Studies, Delhi University (MBA).He is a certified PMP from PMI,USA. In the past, he was associated with Air Works Group as Chief Learning and Development Officer. His role involved analysis of the Business and Regulatory Environment, conceptualisation and implementation of Organisational Level Projects and Programs.

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