September 2023

100 KNOTS

India's Aviation Ecosystem

Safety
Tailstrike Awareness & Prevention

Fatigue Management
Controlled Rest on the Flight Deck

Sustainability
Can Aviation be Truly Sustainable?

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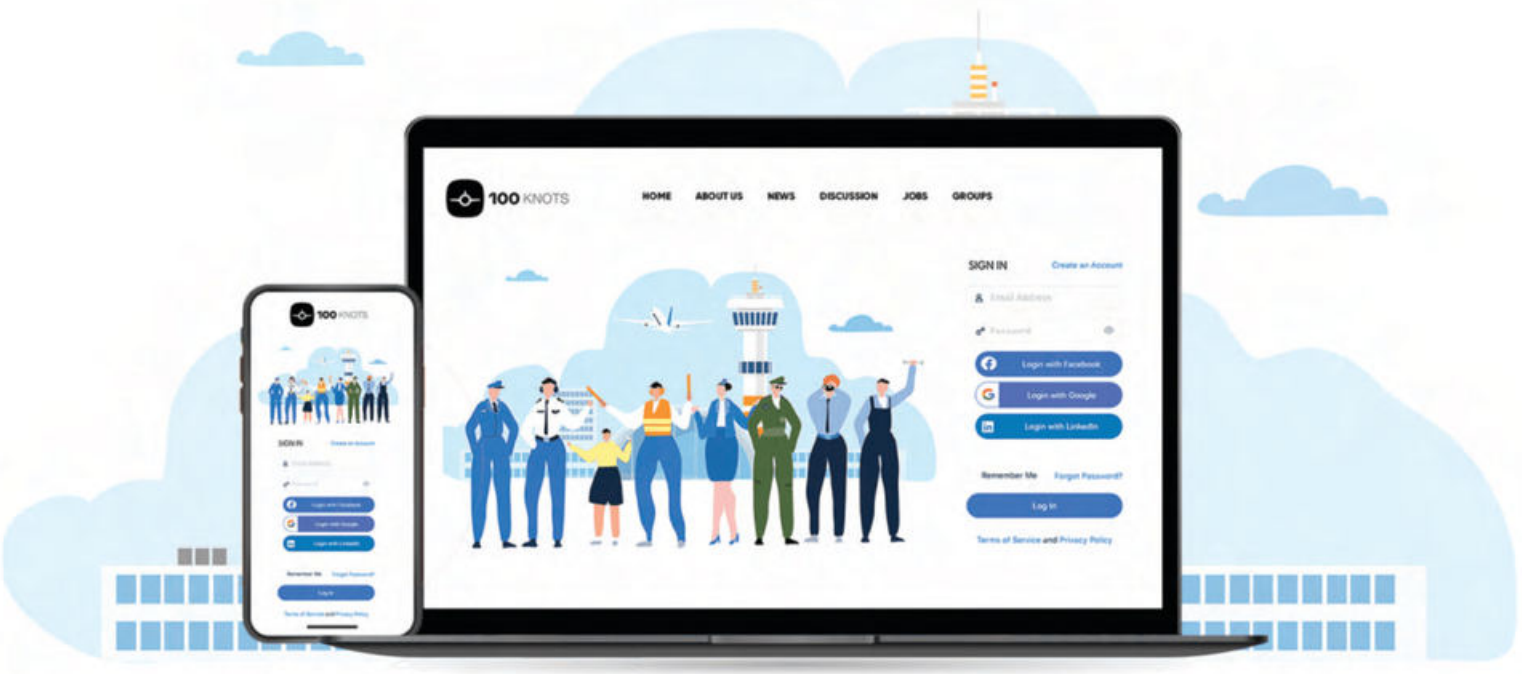

EDITORIAL DESK

Radhika Bansal
Assistant Editor

Dear Colleagues,

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

In the fast-paced world of aviation, safety remains paramount. However, a lurking concern that threatens the very core of air travel safety is pilot fatigue. As we take to the skies with unwavering trust, it is imperative that we confront this issue head-on.

Pilots are the unsung heroes who navigate through the complexities of the skies, ensuring that passengers and cargo reach their destinations safely and efficiently. Yet, the demanding nature of their job, involving irregular schedules, long hours, and often traversing multiple time zones, puts them at risk of fatigue—a condition that impairs their cognitive abilities, reaction times, and decision-making skills. Pilot fatigue isn't just a matter of personal comfort; it's a matter of public safety. Fatigued pilots can compromise their own well-being, as well as that of their crew and passengers. Imagine the consequences of a pilot failing to respond promptly to an emergency situation due to exhaustion. The potential for disaster is evident, underscoring the urgency to tackle this issue collectively.

To address pilot fatigue, a multi-pronged approach is necessary. First and foremost, airlines must prioritize the well-being of their pilots by implementing comprehensive fatigue management programs. These programs should encompass strategies such as optimized work schedules, proper rest facilities, and proactive monitoring of pilot fatigue levels. Governments and aviation authorities must establish clear and enforceable guidelines regarding duty time limitations and rest requirements for pilots. These regulations should be based on scientific research and take into account the cumulative effects of fatigue over consecutive flights.

Equally important is the role of technology in mitigating pilot fatigue. Advanced fatigue monitoring systems can track pilot alertness in real-time, offering early warnings to both pilots and ground control when fatigue levels become concerning. Additionally, flight planning software can consider circadian rhythms and time zone changes to optimize flight schedules, reducing the likelihood of fatigue-induced errors.

Furthermore, cultivating a culture of open communication is essential. Pilots should feel comfortable reporting instances of fatigue without fear of retribution. Such reporting can provide valuable data to refine fatigue management strategies and prevent potential accidents.

As consumers of air travel, we too bear a responsibility. By acknowledging the seriousness of pilot fatigue, we can support airlines that prioritize safety and demand transparent information about crew schedules.

In the pursuit of safer skies, the aviation industry must collaboratively tackle the menace of pilot fatigue. The well-being of pilots is synonymous with the safety of all those who entrust their lives to air travel. Let us champion the cause of fatigue management, ensuring that the skies remain a realm of safety, reliability, and unwavering professionalism.

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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Chief Executive Officer Jazeera Airways

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Rohit Ramachandran, Chief Executive Officer, Jazeera Airways

Rohit Ramachandran, is the first and only Indian Chief Executive Officer to lead a Middle Eastern airline. He is credited with turning Jazeera Airways around, and putting it on the path to profitable growth. During his six-year tenure, he led an ambitious program of restructuring the company, dramatically reducing the cost structure, network expansion and fleet renewal. Under his leadership, the airline also posted consistently rising profits, grew its market cap by a multiple of 7 and its fleet from 7 to 23 aircraft.

Rohit has over 20 years of aviation experience and an MBA in International Marketing and Aviation Law. In 2020, he was elected as a Fellow of the Royal Aeronautical Society.

Tell us about Jazeera Airways!

Jazeera Airways was established in 2004 in Kuwait. It is the first non-government airline in the Middle East and is also the first airline to be listed on the Kuwait Stock Exchange. Jazeera currently flies to more than 64 cities across the Middle East, Central and South Asia, Africa, and Europe. This includes high-demand business, leisure, religious, and weekend destinations. Our fleet of 23 aircraft includes Airbus A320 and A320neo aircraft. In June 2018, Jazeera became the first airline in the Middle East to add the A320neo aircraft to its fleet.

In Kuwait, Jazeera Airways owns and operates its own airport terminal – Jazeera Terminal 5. With a focus on comfortable, convenient and affordable travel, Jazeera has won several awards for its services over the years. This includes the Best Low-Cost Airline in the Middle East.

Strategy for Expansion & Growth?

Globally, we are expanding our network to offer customers more choices for travel across the Middle East, Europe, Central and South Asia as well as Africa. This summer we introduced several new destinations including Belgrade, Tirana, Tivat, Shiraz and Tehran. We also restarted flights to Prague and Sarajevo.

For network expansion, Jazeera Airways uses a data-driven approach to evaluate destinations including passenger demand. We conduct feasibility studies to determine viability and secure regulatory approvals and airport slots for viable routes. Our goal is to offer a wide range of destinations while maintaining a sustainable business model.

In terms of frequency, we aim to offer our passengers a range of options that meet their needs and preferences. We consider factors such as the time of day, day of the week, and seasonality when determining flight schedules. We also monitor passenger demand and adjust our schedules accordingly to ensure that we are offering the right number of flights to each destination.

H1 2023 Results

الجزيرة. Jazeera.

Passengers
2.1m
+40.91% on H1 2022

Load Factor
78.1%
+ 4.15% on H1 2022

Aircraft Utilization
13.53 Hours
+ 9.55% on H1 2022

Staff per Aircraft
63

Group Operating Revenue
KD 97.8m

Terminal 5 Operating Revenue
KD 5.81m

Group Net Profit
KD 6.27m

Market Share
29.5%
vs 28.12% on H1 2022

EBITDAR
17.37%

New Routes

- **Moscow,** Russia — 02 February
- **Samarkand,** Uzbekistan — 01 March
- **Larnaca,** Cyprus — 29 March
- **Sphinx (Cairo),** Egypt — 14 May
- **Shiraz,** Iran — 04 June
- **Tivat,** Montenegro — 04 June
- **Belgrade,** Serbia — 15 June
- **Tirana,** Albania — 28 June

Benefits of Flying with Jazeera Airways

At Jazeera Airways, we are committed to providing a high-quality travel experience that exceeds customer expectations. We have implemented various measures to ensure on-time performance, such as optimizing flight schedules and managing a well-maintained fleet. We also offer affordable fares and flexible booking options to make travel planning easier for our customers. We deliver a hassle-free and courteous customer service experience, focusing on providing a personalized and comfortable travel experience. Besides offering convenient connections, we also have a comfortable layover area at our own airport terminal in Kuwait - Jazeera Terminal 5. To ensure a continued focus on improvement, we regularly solicit feedback from customers and use this input to further enhance our services and offerings. Overall, we are dedicated to providing a safe, reliable, and enjoyable travel experience for all of our customers.

We also recognize the importance of sustainability and are committed to reducing our environmental impact. One of the ways we are achieving this is by implementing a range of sustainable initiatives across our operations. For example, we have invested in new, fuel-efficient aircraft that reduce our carbon emissions and fuel consumption. The A320neos in our fleet reduce CO2 emissions by 50%, engine noise by 50% and increase fuel efficiency by 18%. Jazeera is the first Kuwaiti airline and the region's first Low-Cost Carrier (LCC) to implement a climate compensation initiative CHOOOSE™ that helps passengers offset their carbon impact.

How is your in-flight product different?

Jazeera Airways ensures affordable fares and convenient flights for a positive passenger experience. Passengers can select seats online to ensure maximum comfort during the flight. They can also pre-order in-flight meals online through our J Café. For inflight entertainment, we provide Jazeera screens that you can use on your own mobile device, with a wide selection of movies, TV shows, and music.

We recently introduced pre-ordering of Duty Free and On-board shop items online. Passengers can opt to pre-order items from an extensive collection of luxury perfumes, jewellery, electronics, tobacco and other gift items from the Jazeera Duty Free or On-board shop to receive them on their flight. To buy any products, passengers simply have to add them on from the Travel Extras option when booking flights through our website or app up to 24 hours prior to departure. All shopping can be done through a debit or credit card safely and securely. Items will be delivered to passengers on-board their flight. Prices of all pre-ordered items will be up to 15% lesser that those purchased in-flight.

Presence in India

We have been operating in India for over five years. Starting with Hyderabad in the year 2017, we grew our network to cover six cities in the country. Our pan India network connects Mumbai, Delhi, Hyderabad, Kochi, Chennai, and Bengaluru direct to Kuwait. Jazeera Airways has been well-received by Indian travellers mostly expats that appreciate affordable fares, direct connectivity, quality service, and convenient flight timings.

Starting from booking flights on our user-friendly website or mobile app to service- oriented staff, Jazeera Airways strives to offer the best value for customers on every journey.

Outlook towards the Indian Aviation Market

During the last few years, LCCs in India have played a very important role in making air travel more affordable for the average Indian traveller. This has attracted a growing number of middle-class consumers to LCCs. The growing number of middle-income households has thus led to an increase in air travel demand. The rise of international tourism has also been a significant driver of growth for the aviation industry in India.

Growth and expansion plans in India?

We are keen to expand our network in India to serve the large expat population in Kuwait. However, this requires a larger seat allocation. The seat capacity allocated to us has not increased since 2007 when the Indian population was around 300,000 only. The current population of Indians in Kuwait is over 1 million.

We currently serve six cities in India, connecting directly from Kuwait, which makes Jazeera an ideal option for the large expatriate community in the country to travel back home.

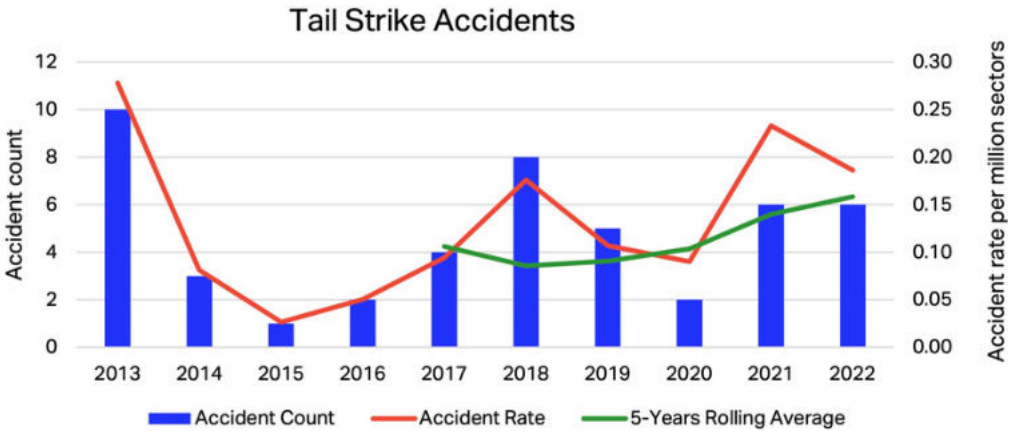
Are you eyeing any possible codeshare / Interline agreements with Indian airlines?

We have not explored this possibility in India. But we continue to scope opportunities for new partnerships and alliances with other airlines to enhance our offerings and provide more benefits to our passengers across our network.

Tailstrike

Awareness & Prevention

PP Singh
Ex-Accountable Manager
Jet Airways



On August 12, 1985, a Japan Air Lines Boeing 747 aircraft crashed in the area of Mount Takamagahara, about 100 kilometres from Tokyo, shortly after departure. Japan's Aircraft Accident Investigation Commission (AAIC) concluded that the structural failure was caused by a faulty repair by Boeing technicians following an earlier tailstrike event. When the faulty repair eventually failed, it resulted in a rapid decompression that ripped off a large portion of the tail and caused the loss of all on-board hydraulic systems, disabling the aircraft's flight controls.

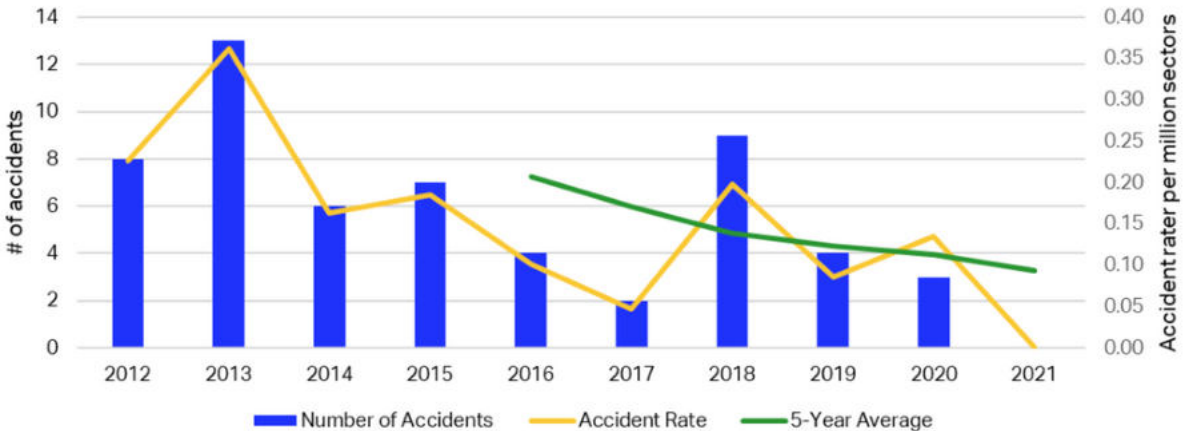
Out of the 524 passengers and crew aboard, only four survived. The crash of Flight 123 remains the deadliest single-aircraft accident in aviation history and, unknown to most people, was the delayed consequence of a tailstrike seven years ago at Osaka airport.

What is a Tailstrike?

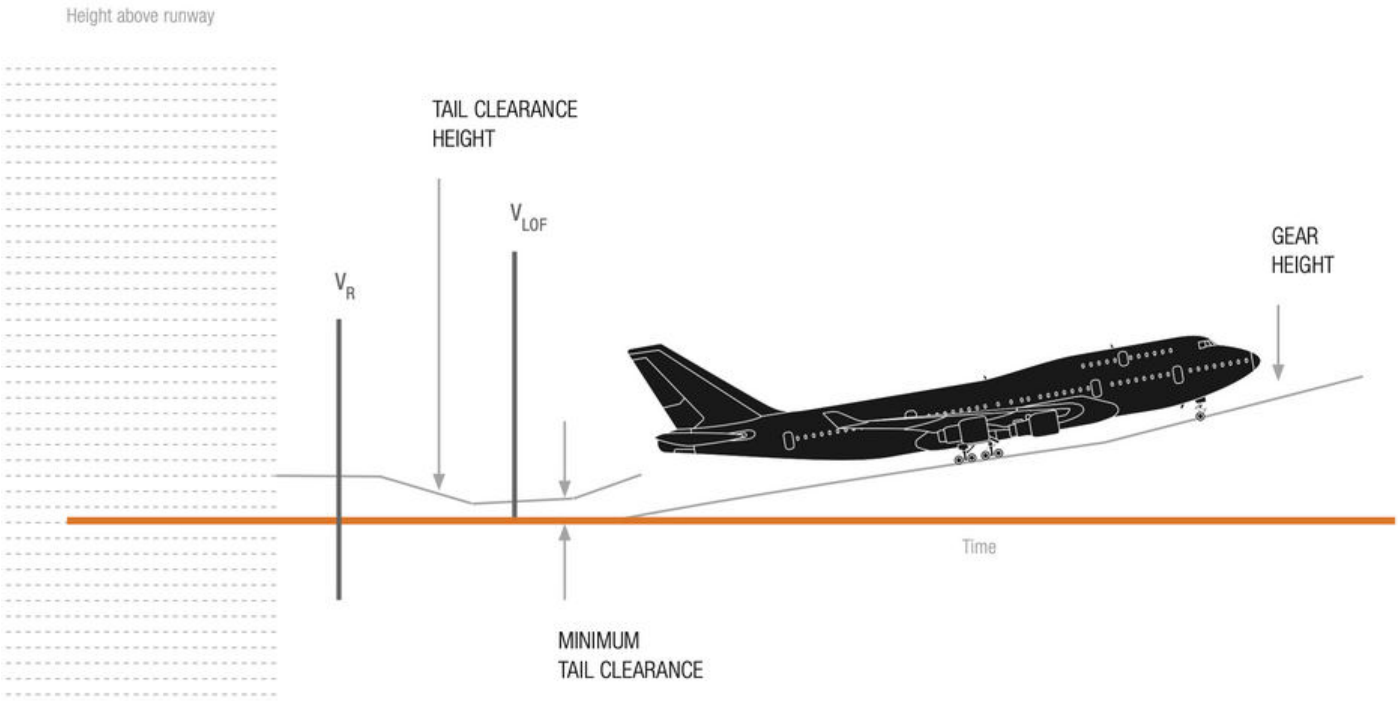
A tailstrike is said to occur if the tail of an aircraft touches the runway during takeoff or landing. Tailstrikes can result in significant structural damage to the aircraft and, therefore, jeopardize the safety of the flight. Statistically, about 35% of reported tailstrikes occur at takeoff and 65% at landing. Tailstrike occurrence is directly related to pitch attitude achieved during takeoff or landing and whether the main landing gear struts are extended or compressed. The overall longitudinal geometry of the type of aircraft is the major constant that dictates if a particular model or variant is more prone to tailstrikes than others.

To understand the vulnerability of a particular aircraft, it is important to understand the term 'Geometrically-Limited'. An aircraft is said to be geometrically limited if, at its maximum angle of attack, while the main landing gear is on the ground, the maximum lift coefficient is not reached. In other words, the tail can hit the ground before the wing is able to reach a pitch angle that would produce the maximum lift. Almost all commercial airplanes are generally geometry-limited, which leads to the obvious deduction that a tailstrike is always a possibility in airline operations. Hence, it is crucial that all stakeholders are constantly aware of the threat and that proper preventive strategies are put in place. It should be understood that the operating crew may not always be aware that a tailstrike has occurred because the impact is seldom felt.

The causes of tailstrikes at takeoff and landing are not identical and need to be examined separately. It is usually difficult to determine one specific cause for an event, and several contributing factors, including adverse weather, can be involved.



Takeoff



The causes of a tailstrike during takeoff can be broadly identified as an inappropriate rotation technique and premature rotation. However, the specific operational and human factors involved and the possible preventive strategies can be listed as follows:

Early Rotation

An incorrect VR will cause an early rotation that will lead to an increase in pitch attitude at liftoff and, as a result, a reduced tail clearance. When the calculated takeoff speeds are not correct for the actual aircraft weight or flap configuration, early rotations can occur. The reasons for the wrong rotation speed can be using a lower than actual aircraft weight, an incorrect speed calculation, a simple FMS/EFB typing error, or confusion in callouts, especially when there is a significant difference between the V1 and VR. Both flight crew members should cross-check the VR to verify that the inserted value is appropriate for the aircraft weight and configuration. It should be noted that in some unforeseen situations, like an obstacle on the runway or a windshear, an early rotation may actually become a safer course of action, even at the risk of a tailstrike.

Excessive Rotation Rate

Rotation rates that are too fast increase the risk of tailstrike. This is especially a risk on aircraft that may have a large inertia (stretched fuselage variants and widebody aircraft), since the initial rotation rate produced by a given pitch input takes time to build up. The pilot may sense a delay in the rotation, which can lead him to overreact by making large pitch inputs. At VR, the flight crew should initiate the rotation with a smooth positive control input in order to achieve a continuous rotation rate of approximately 3°/sec and avoid aggressive and sharp inputs

Improper Use of the Flight Director

The flight director (FD) is designed to provide accurate pitch guidance only after the airplane is airborne, nominally passing through 35 ft. With the proper rotation technique, the airplane reaches 35 feet with the desired pitch angle of about 15 degrees. However, an aggressive rotation into the FD-commanded pitch at takeoff may rotate the tail into the ground.

Erroneous CG position or Mistrimmed Stabiliser

The main purpose of the pitch trim setting for takeoff is to provide consistent rotation characteristics. If, for any reason, the trim setting does not match the CG position, the aircraft will not rotate as usual. With an aft CG or the pitch trim erroneously set to the nose-up direction, the flight crew might encounter an early and aggressive rotation, sometimes well before the VR is reached.

Thrust/Weight Ratio

The possibility of a tailstrike increases during takeoff with low thrust/weight ratios. Heavy aircraft taking off from high-altitude airports or in hot conditions are more sensitive to tailstrikes than other aircraft. When performance limits the takeoff weight, the flight crew should use the maximum thrust available and select the configuration that provides the highest takeoff weight. When the actual takeoff weight is lower than the maximum permitted weight, the flight crew uses reduced takeoff thrust and usually selects the configuration that provides the maximum flexible temperature in order to increase the engine lifespan. The highest flexible temperature is obtained with the highest flap configuration on short runways, but with the lowest flap configuration if the runway is long. Therefore, the optimum configuration for flexible temperature may not be the same as the optimum configuration for tail clearance. The flight crew should be aware that the highest flap configuration provides the highest tail clearance.

Slats / Flap Configuration

For a given aircraft weight, a variety of flap configurations are possible. In general, a high flap configuration decreases the probability of a tailstrike by reducing the required pitch for liftoff. But airlines generally encourage the use of the lowest available flap setting to reduce fuel burn.

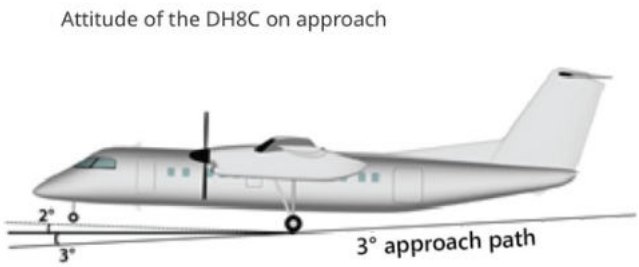
Crosswind

In the case of crosswind, the flight crew may use lateral control inputs on the ground and during rotation in order to help with directional control. If the spoilers are extended on one wing, there is a reduction in lift combined with increased drag and, therefore, a reduction in tail clearance. Strong gusty winds may cause a loss of airspeed or a requirement for lateral flight control inputs that can deploy some flight spoilers, reducing the amount of lift on the airplane. If there is a crosswind during takeoff, the flight crew should avoid large lateral inputs in order to avoid spoiler extension.

Main Landing Gear Oleo Inflation

The correct extension of the main landing gear shock absorber and the resulting nominal increase in tail clearance during rotation depend on the correct inflation of the oleos. An underinflated oleo will decrease the tail clearance. Maintenance personnel and flight crew should pay attention to the oleo extension during the external walk-around.

Landing



The causes of a tailstrike during landing may be broadly identified as unstabilised approaches and deviations from normal approach and landing techniques. A tailstrike at landing often occurs on the second touchdown, following a bounce, and is frequently associated with a hard landing.

Although most landing tailstrikes are due to deviations from normal landing techniques, some are associated with external conditions, such as turbulence and wind gradient. Tailstrikes at landing generally cause more damage than tailstrikes at takeoff because the tail may strike the runway before the main gear and cause damage to the aft pressure bulkhead.

Usually, no single factor will result in a tailstrike, but the combination of several factors can significantly erode the tail clearance margin (the distance between the aircraft tail and the ground).
The specific operational and human factors, along with the possible preventive strategies that increase the probability of a tailstrike during landing, can be listed as follows:

Decrease in Speed (well below Vapp) Before the Flare

Flight at too low a speed results in a high angle-of-attack and a high pitch attitude, and therefore reduced tail clearance. When the aircraft reaches flare height, the flight crew must significantly increase the pitch to reduce the sink rate. This will further reduce ground clearance and increase the risk of a tailstrike.

Sink Rate Too High Just prior to reaching the Flare Height

If the sink rate is too high when the aircraft is close to the ground, the flight crew may attempt to avoid a firm touchdown by commanding a high pitch rate. This action will significantly increase the pitch attitude. The high pitch rate may be difficult to control after the touchdown, particularly in the case of a bounce. For the approach phase, the flight crew should not chase the glide slope close to the ground and carefully monitor the pitch attitude and sink rate.

Flare Too High

A flare that is too high can result in a combination of decreased airspeed and a long float. Since both lead to an increase in pitch attitude, the result is reduced tail clearance. The flight crew should adapt the flare height to the aircraft's inertia. It is imperative that the aircraft reach the flare height at the appropriate airspeed and flight path angle. During the flare, the flight crew should concentrate on the pitch and roll attitude, using external visual cues.

Prolonged Hold-Off for a Smooth Touchdown

As the pitch attitude increases for flare, the flight crew must assess the aircraft's position in relation to the ground. They should avoid holding the aircraft off by increasing pitch in an attempt to make an excessively smooth landing. The PNF should continue to monitor the attitude for excessive pitch angle.

Bounce at Touchdown

In the case of a bounce at touchdown, the flight crew may decide to increase the pitch attitude to ensure a smooth second touchdown. If the bounce results from a firm touchdown associated with a high pitch rate, it is important for the flight crew to control the pitch so that it does not continue to increase. Automatic spoiler extension also induces a pitch-up effect.

Crosswind

When the aircraft is close to the ground, the wind velocity tends to decrease and the wind direction tends to turn (direction in degrees decreases in northern latitudes). If the airplane then descends into a turbulent surface layer, particularly if the wind is shifting toward the tail, the resulting sink can cause the crew to instinctively increase the pitch attitude beyond the geometry limit. The flight crew should be aware that during the approach phase and especially during the flare, a crosswind effect could suddenly increase the pitch of the aircraft and result in a tailstrike.

Over-Rotation during Go-Around

A go-around initiated close to touchdown, such as during the flare or after a bounce, is a common cause of tail strike. When the go-around mode is initiated, the FD immediately commands a go-around pitch attitude. If the pilot abruptly rotates into the command bars, tail strike can occur before a change to the flight path is possible, especially if the engines are just spooling up.

Conclusion

None of the 524 occupants of JAL 123 in August 1985 could have had the faintest inkling that an incident from 1978 involving the same airplane would seal their fate. During a landing in Osaka seven years before, the pilot had pitched the plane's nose too high and slammed the tail into the runway. The resulting impact mangled the rear lower fuselage of the jumbo and caused injuries to 25 passengers.

Many technical lessons were learned during the JAL 123 investigation, leading to significant aviation safety improvements. One may ask- does such learning get applied widely enough in the industry and get the desired outcome? The answer is no; and the fact remains that much more needs to be done to prevent such accidents. Tragically, years later in 2002, a China Airlines Boeing 747 broke up in flight near Taiwan because of structural failure. The investigation revealed that a tailstrike 20 years ago had severely damaged the lower aft fuselage area. The airline performed the repair improperly, and the fatigue-related failure led to the catastrophe, just like the bulkhead situation on JAL 123.

Tailstrikes are mostly preventable. If standard recommendations are followed, the chances of a tailstrike are greatly diminished, but challenges remain when operating in strong and gusty winds. Training is the key to preventing tail strikes. Tailstrike prevention should be part of the training programs due to the fact that many flight crew actions can be improved to help minimize the risk. Technology enhancements such as pitch limit indicators and aural alerts can also contribute to the solutions.

About the Author

As the Ex- Accountable Manager and Vice President for Jet Airways (India) Ltd, Capt PP Singh was the Key Management Person in this world-famous airline brand's resolution and revival process. He has been an aviation professional since 1984, possessing extensive training and checking experience accrued with major Indian and foreign international carriers as an instructor and examiner on large commercial jets. Over the past three decades, Capt Singh has held crucial appointments in the senior management teams of Jet Airways and Nepal Airlines in various regulatory and leadership roles. After graduating from the University of Delhi, he started his aviation career with the Indian Air Force and moved to civil aviation in 1994. His most recent responsibility is the operations, training, safety, and engineering functions of Jet Airways.

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Can Aviation Truly Be Sustainable?

Grégoire James
Commercial Director
International Aviation Waste
Management Association (IAWMA)

Environmental awareness is at an all-time high, and the aviation industry is racing to increase accountability toward its global carbon reduction and sustainability footprint. With acts of sustainability rarely performed in silos, driving and meeting agendas requires engagement from a broad cross-section of stakeholders, both within the industry and on its periphery.

With no shortage of ideas, strategies, business models, carbon mitigation schemes, alternate fuels, and start-ups, the interest to drive change is clear. Sustainability needs to incorporate the continuation of profit to ensure adoption while appealing to the consumer's desire to do the right thing.

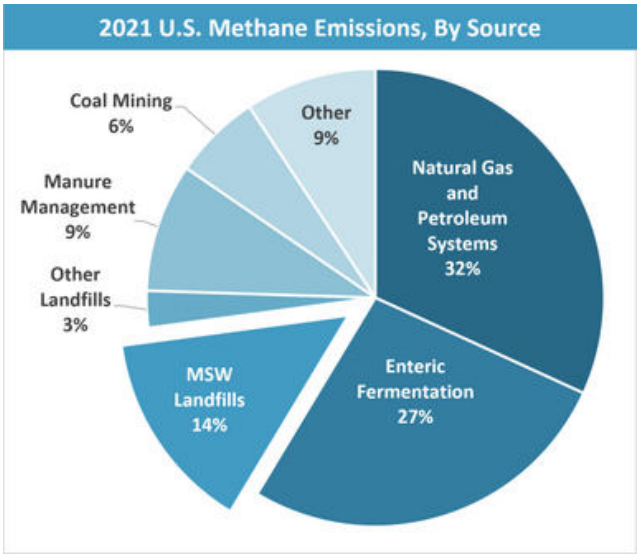
Moving the needle means driving natural and technological improvements to support the path to zero emissions and closed loop recycling. But can these improvements achieve desired goals and more importantly, will evolving strategies keep up with the pace of the ever-changing definition of sustainability?

Bear with the analogy here, environmental strategies require definitive parameters. For example, what is the strategy looking to achieve, how will its delivery occur, and how will expectations be met? As definitions are different for everyone, and their essential nature, too, can change over time, future sustainability will have to include activities that are not even on the radar today.

As sustainability evolves and changes, similarly supporting industries will also have to constantly evolve to keep up with the pressing needs generated by societal awareness. This very awareness drives corporate sustainability plans to appease investors, consumers, and regulators and, sometimes, just do the right thing. Today we talk about the functional ability to demonstrate carbon mitigation, solid waste reduction, and water optimization; carbon mitigation was not a focal point until recently.

In contrast, the effects of waste and landfill emissions are only starting to gain awareness in the minds of the traveling public and, given the aviation industry's strategies for its waste functions are currently limited in capacity, it too must embark on aggressive goals to ensure environmental accountability.

Landfills are a significant contributor to climate change due to methane emissions. Methane emitted from landfills is 80 times more harmful than CO2 for 20 years after it is released. Therefore, for aviation to be sustainable into the future, it must refrain from contributing to landfills, to which it contributes significantly at present.



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With sustainability agendas coming from the highest levels of the C suites in response to new levels of awareness, new industries are being developed in reaction to ensure industry demands are met and to alleviate investor, consumer, and regulatory pressures, which, if not met, could result in increased costs and/or decreased revenues.

With the current limits of circular economy embedment or even basic recycling in aviation, even in the most advanced cities, without a tangible, solid waste reduction strategy, the industy will be out of step, with passengers' desires for global sustainability.

These factors address societal demands today, but what about future sustainability? With new levels of awareness and the spectrum of definitions of sustainability ranging widely, the fundamental meaning of sustainability is a moving target. So, for aviation to become sustainable, it also must change, and evolve to keep up with the demands and expectations of society.

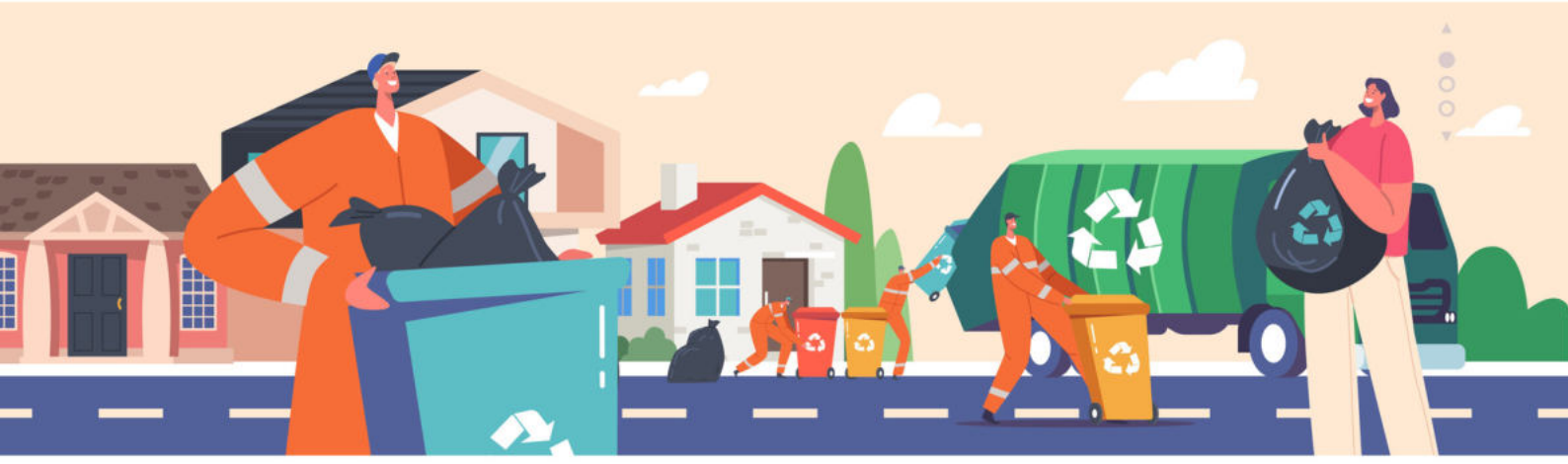
Report Summary

With the pandemic not far from our memories, one of the most powerful outcomes of this global event shows it has shaped our views on sustainability developing ideas on how to move forward. Just at the peak of the pandemic, a multi-year study of policy, regulations, and practices in over 50 countries, including interviews with over 3,500 cabin crew, managers, operational policymakers, and leaders, was published. A real time overview of how the industry functions, and how it sees itself.

The FAA-sponsored Recovering International Recyclables from In-flight Service (2020) was published by the National Academies of Sciences in Washington. The goal was to understand how arriving international flights handled resource recovery and use it to determine whether items must be disposed of by incineration, sterilization, or grinding into an approved sewage system. The report, see summary below, reviewed near and long-term recycling challenges and opportunities, costs, cost savings, and opportunities for revenue generation as well as guidance, for how airports can partner with a variety of stakeholders.

Report Quote

"When exposed to certain foods or fluids, recyclables arriving on international flights are required to be quarantined due to potential contaminants. As a result, almost every country worldwide prescribes sterilization, incineration, or other disposal methods for these contaminated recyclables. Recovery, and the eventual recycling of International Recyclables from In Flight Service, is a practice that is generally permitted if items are kept isolated from contamination by defined food or food items. Adherence to specific protocols is also mandatory to ensure recyclables are recovered under certain conditions, and these 'Non-Contaminated Recyclable Materials' (NCRM) may be recovered and recycled in most markets around the world."



The report incorporated many strategies but ultimately pointed out that the industry was devoid of standards, collaborations, programs, and resource recovery initiatives, and inherently lacking needed knowledge dissemination. The three key levers needed to advance the industry's waste narrative are: cross-sector and functional collaboration; the bridging of supply and collection chain gaps; and the ability to communicate tangible and measurable results. These results relate to:

On-Site Processing

To aid and abet the recovery of materials, which is currently still restricted, focus should be paid to source separation and on-site processing. Through material separation during airport ground operations, as well as short-term storage on-site processing can aid in the recovery of materials, which can be beneficial to the circular economy. In conjunction with airline engagement, airport operators can use the resources at their disposal, such as their land-based operations and infrastructure, to develop on-site solutions.

Standards

Airports and airlines inbound recycling is fragmented, and by developing and adopting standard products, processes, and services, they can better handle their shared obligations. Unfortunately, even if current policies were modified, the activities required for recycling to occur among all stakeholders is still missing. Recycling is a shared obligation, and everyone needs to be encouraged to participate. If only one party is recycling, results will be only partial, as recycling activity outputs, like sorting on the aircraft, are.

Standard handling techniques for recovery would increase visibility of tasks among and the recovery of resources. With standards developed and executed the ability for increased adoption would make the industry truly sustainable. Standards are valuable because they ensure shared and common behaviors and concerted participation even at different stations.

Consistent Handling Practices

With standards could come shared and consistent handling practices, supporting repeated and known behaviors that all stakeholders can plan for and rely on. With shared handling practices, airport operators at various locations could foster increased collaboration. With uniform recovery, increased airline adoption would follow establishing shared procurement and collection visibility, as sustainable practices after all, is a non-competitive activity that should be shared. Current silo solutions and fragmented procurement strategies limit sustainability and prevent shared handling practices, shared recovery, and eventual throughput efficiency. It was determined that, currently, neither airport operators nor airlines were fully engaged in recovery.

Due to varied airport collecting processes, airlines simply don't have the support needed to enhance adherence to various and ever-changing schemes. On the other hand, airports frequently require assistance with the complexities of incoming airline waste because each airline has its own custom procedures. Furthermore, airlines cannot always separate waste in accordance with each government legislation and airport operational policy. Think, 100 different procedures for 100 different airports. As a result, rather than segregate waste, airlines chose to follow the maximum authorized quarantining.

Supply Chain and Procurement

Supply chain and procurement advancements were found to also be a big missing piece of the puzzle. Each airline procures materials devoid of strategies for their collection, and the reality is supply chain activities could mitigate fragmentation almost immediately with planned adoption. With harmonized supply and procurement, the starting point would be instrumental in determining the outcome of future and ongoing waste collection efficiencies. Airlines could ensure visibility and continuity when determining if items should be categorized as waste, or international waste, which they currently cannot guarantee. That requires standards or standard-like activities.

Many countries accept recyclables that have not been contaminated with fluids or food residues and will thus accept non-contaminated recyclable materials (NCRM) into local recycling systems legally. Airlines that have successfully recovered resources from international inbound flights provide their in-flight cabin employees with further training on separation techniques. Airport operators who frequently have the opportunity to gather recyclables with these protocols in place can do so with shared supply chain and procurement strategies so long as the process is continuous.

Policy Adherence

With international industry comes inescapable global policy adherence along with a myriad of compliance issues that work to mitigate local needs. Within these policies, airlines and airport operators work tirelessly to ensure they follow existing guidelines, and NCRM and its recovery are no different. Existing regulatory policies are complex with embedded reasoning which aviation cannot address, and airlines may be held responsible for any breach, should they occur. Having standards that can mitigate risk assessments may be required and could be utilized with the assistance of enforcement officers to help airport operators deliver NCRM programs that could be adopted by additional airlines.

An opportunity exists for airport operators to ensure industry stakeholders follow existing policies regarding NCRM and their recovery. Risk assessments can be utilized in conjunction with the assistance of enforcement officers to help airport operators deliver NCRM programs that could be adopted by more airlines. The industry can streamline and standardize NCRM recovery to boost airline and airport sustainability, stakeholder involvement, and throughput effectiveness for resources, ultimately adhering to policy. The issue is that should policies change and a breach occur, the industry may be inherently at risk of rectifying these breaches.

With NCRM standardized, policymakers could identify specific recovery initiatives in line with their initially planned policy goals that would succeed. Airport operators could significantly contribute to the systematic collection of NCRM by strictly adhering to policies. All airport operators should streamline and standardize the NCRM recovery procedure to increase airline participation and throughput efficiency. By generating more consistent collection across more airports, policymakers could be confident NCRM recovery can succeed in line with their initially anticipated policy goals. By carefully following rules, airlines and airport operators might significantly contribute to the systematic gathering of NCRM.

Waste Collection

Waste collection in the airline industry is mainly limited to linear one-way practices. Currently, with these practices, waste management companies focus on providing airlines and airports with pick up and disposal of their waste. Waste Management industries are not necessarily vertically integrated into the industry and therefore challenged with delivering sustainability activities overall.

Partnering with the waste collection industry can be valuable to support the recovery of recyclable materials and its strategy to advance systems and processes to establish waste diversion goals in recovering resources. Airport operators can also work with the waste industry to support compliance activities and promote future airport infrastructure needs.

Together, airports, airlines, and waste management companies can improve the overall ecosystem management and collection of waste and recycling by developing collection systems for recyclable materials with much greater ability to do so already. This robust collection system can also influence airlines to improve onboard separation practices and motivate the global industry to start hearing tomorrow harmonizing collection practices in streamlining their sustainability activities through these non-competitive advantages.

The summary of what waste management sustainability looks like and what waste recovery mitigation activities must occur within a supply chain and for the reverse logistics necessary to ensure proper circularity and active processing. Carbon mitigation aside, many aspects of sustainability today are still functions of awareness. We are only working towards the sustainability of those aspects of which we are aware. The adage - there are no new inventions, only new discoveries - holds true for sustainability.

Highlighted with waste reduction are a whole host of activities studied and published by them as they are most likely to feel they contribute to or impact waste reduction through increased recycling. The findings are being adopted in many markets and industries. The definition is different for everyone, and while carbon reduction may be the focal point to ensure accountability and transparency, representing a challenging task, the industry is subject to hundreds if not millions of products not designed for circular sustainability and, coupled with its international activities, subject to various recovery programs, or lack thereof, in varying markets.

Contrary to popular belief, waste does not simply degrade in a landfill. In fact, landfills can and may be a source for mining in the future, which has already been carried out in a limited manner. At the very least, linear consumption practices need to be reassessed. Landfill waste, afterall has implications for future liability which industries could be held responsible for as has been the case for soil and water contamination in several industries. Depending on an unabated consummation model could be risky and may benefit from limiting unabated linear practices.

Even with advanced recovery activities commencing in many markets, exposure to liability, and managing landfills to the highest acceptable standards, we are still at risk for environmental contamination from leaking landfills, putting groundwater at risk. Leachate leakage can be reduced by liners and leachate collection systems. However, liners could break down and systems may not catch all of the leachate that leaks from a landfill.

Many liners have a two or three-hundred-year lifespan. Think about it, how can one repair or replace a liner without digging up the entire landfill?

The airline sector, like many industries, is subject to much scrutiny. Can it recycle, does it recycle, how can it recycle? Criticism often focuses on the industry's lack of reuse and recycling of cabin and airport waste; however, the industry already does a tremendous job at implementing recovery programs and mitigating waste in the first instance. So, while waste is subject to regulations, the reality is that every airline can recycle 100% of its waste, including food waste, with a bit more effort and investment.

So where do we go from here? U.S. Travel & Tourism Statistics for 2020-2021 stated that, in the U.S. for example, annual domestic and international travel totals 2.29 billion domestic trips annually with outbound tourism amounting to 93.0 million trips and inbound totaling 79.6 million international visitors. This represents roughly 8.2% of total international traffic, versus 3.8% inbound international travel.

Recyclables from flights can be legally handled within domestic operations, yet materials are still disposed of rather than recycled. So perhaps supporting robust collection of domestic traffic is a good place to start, because at current, even these activities occur in limited numbers. Internationally, recyclables arriving on international flights must be quarantined due to potential contaminants. Nevertheless, in most countries, recycling can occur with added sterilization to allow for the recovery of contaminated recyclables. Since recovery and recycling are permitted domestically and since 93% of flights occur in this realm, where is the robust recovery? Perhaps with domestic recyclables recovered, many airports and airlines can immediately increase sustainability and even generate some revenue streams from this source.

About the Author

Gregoire James is the Commercial Director of the International Aviation Waste Management Association (IAWMA), founded after global research on the recovery and recycling of single-use items in the aviation industry. He leads the development of global aviation waste standards for products, processes, and services in global commercial and business aviation, airports, and flight kitchens with SAE International, the largest consensus-based standards development organization in the world.

Controlled Rest on the Flight Deck

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Fatigue & Circadian Rhythm

Fatigue is defined by the International Civil Aviation Organization (ICAO) (2015, page xiii) as:

A physiological state of reduced mental or physical performance capability resulting from sleep loss, extended wakefulness, circadian phase, and/or workload (mental and/or physical activity) that can impair a person's alertness and ability to perform safety-related operational duties.

Circadian phase refers to the timing of the internal circadian body clock that synchronizes physiological systems to promote wakefulness during daytime, and sleepiness during nighttime. Therefore, fatigue can arise when attempting to maintain wakefulness at night, especially during the window of circadian low (WOCL) that is close to the nadir in body temperature, or as a result of insufficient sleep attempted during the day. The circadian clock is primarily entrained by light exposure. Traveling to different time zones can cause desynchrony between the internal circadian body clock and the external light environment. This desynchrony can cause jetlag symptoms that include fatigue.

Fatigue Risk Management in Aviation

Flight crew fatigue can negatively affect performance and pose a hazard to flight safety. Fatigue also has a negative impact on learning, morale, and health. Regulators are increasingly requiring operators to do more than comply with flight and duty time limitations to manage crew fatigue. Such requirements include demonstration of effective fatigue risk management (FRM) within a safety management system (SMS), or with a dedicated fatigue risk management system (FRMS). The extent to which an operator effectively manages fatigue, like any risk, depends on the effectiveness of the system of controls that are in place.

Despite the best efforts of operators and flight crew, there will always be situations in which flight crew experience unanticipated elevated fatigue in-flight. Alertness levels can vary considerably during the course of a flight, particularly a long flight, or a flight during the WOCL. In addition, research that evaluates augmented long-haul flights has shown that crew are not always able to obtain sleep during scheduled rest periods in on-board rest facilities. In addition, unexpected events such as delays and high workload due to weather can increase the risk of an error due to fatigue.

Napping Helps

Sleep loss, due both to a bout of extended wakefulness (acute sleep loss) and repeated insufficient sleep (cumulative sleep loss), leads to degradation in alertness and cognitive performance. In addition, individuals who are sleepy but not permitted to nap are more likely to experience unintentional lapses in alertness and attention. Unintentional napping (i.e., falling asleep without planning to) has been objectively observed and self-reported in various shiftwork populations, with up to 20 percent of nightshift workers falling asleep at work.

In aviation, Rosekind et al. (1994) measured objective alertness using electroencephalography (EEG) in the cockpit and found that, compared to flight crew who were afforded a 40-minute in-seat nap opportunity, those not provided with a nap opportunity were twice as likely to have a micro-sleep event during critical phases of flight, including descent and landing. During cruise, four of the nine observed flight crew who did not have a nap opportunity, unintentionally fell asleep on five occasions, sometimes for more than 10 minutes.

Together, these studies highlight the prevalence of sleepiness and unintentional sleep when at work, and highlight the potential benefit of CR to maintain alertness and performance, and to reduce the risk of unintentional events.

Laboratory and field research have demonstrated that napping can counteract the adverse effects of sleep loss on alertness and performance (Milner and Cote, 2009; Ruggiero and Redeker, 2014). For example, an ap- proximately 30-minute nap taken around 0300 during a night shift has the potential to improve performance for the remainder of the shift that might end at 0600 or 0700 (Purnell et al., 2002; Smith et al., 2007; Lovato et al., 2009), but this finding is not consistent (Centofanti et al., 2016). The duration and magnitude of nap benefits, and the results of these studies, depend on a number of factors including the length, timing, and quality of the nap, as well as the prior sleep-wake history of the individual.

What is CR?

CR on the flight deck is a short sleep opportunity, defined by ICAO (2015) as an effective mitigation strategy to be used as needed in response to unanticipated fatigue experienced during flight operations. In accordance with an approved CR procedure, one flight crewmember is temporarily relieved of operational duties, and takes a short, in-seat rest break, during which he or she closes his (or her) eyes and attempts to sleep. CR enables a flight crewmember to use a period of low workload to obtain a brief period of sleep and thereby improve alertness and performance, particularly for later, more critical phases of flight such as descent and landing.

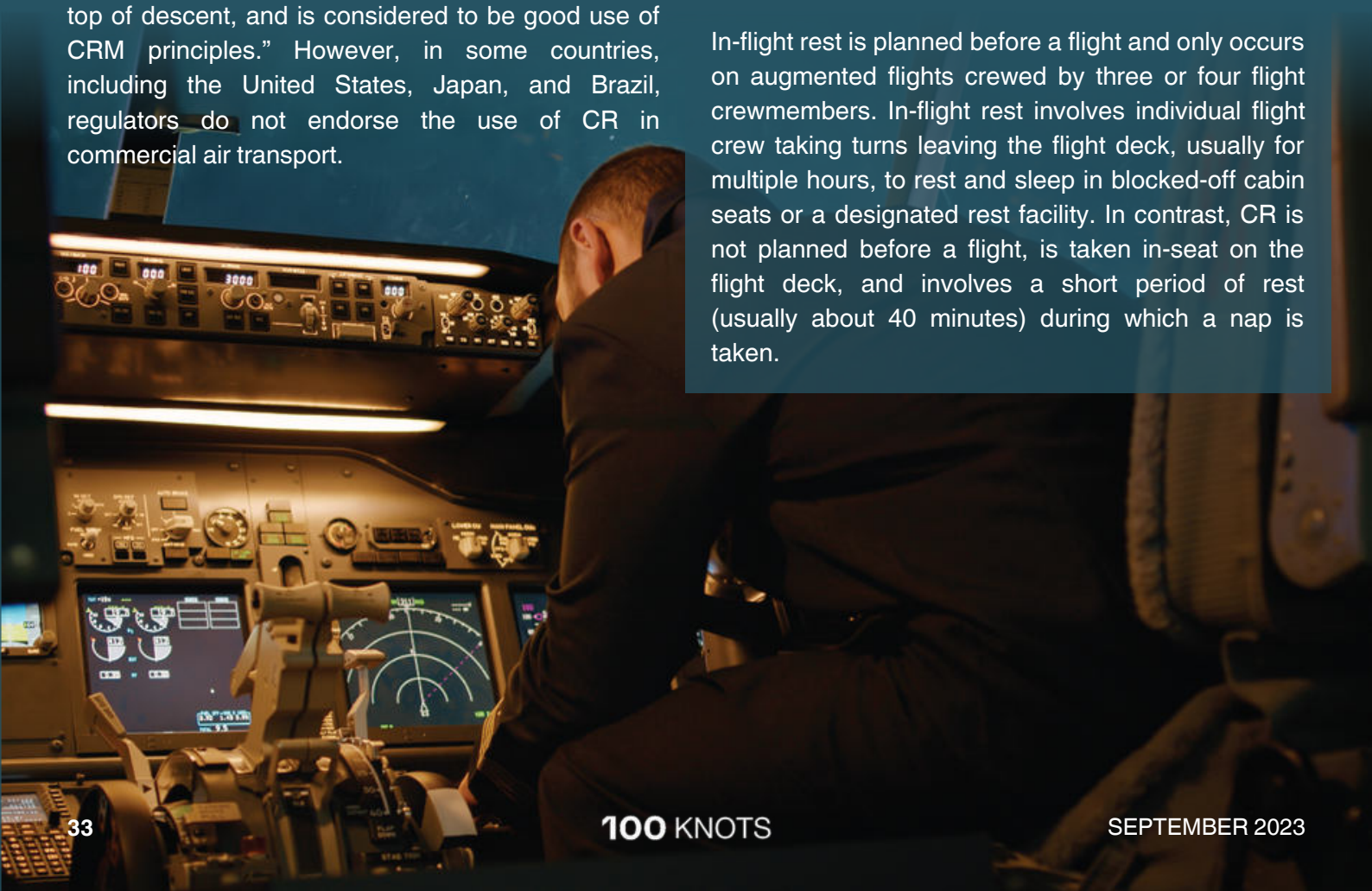
CR is recommended by ICAO (2015) and the Aerospace Medical Association as an effective fatigue management strategy, and is practiced in regions including in Europe, Canada, Australia, Singapore, Hong Kong, and the Middle East. The European Aviation Safety Agency (EASA, 2014) states that, "the use of controlled rest has been shown to significantly increase the levels of alertness during the later phases of flight, particularly after the top of descent, and is considered to be good use of CRM principles." However, in some countries, including the United States, Japan, and Brazil, regulators do not endorse the use of CR in commercial air transport.

Studies of CR on the flight deck

In the late 1980s, the first study of the "NASA Nap," involving three minutes of preparation, a 40-minute nap opportunity, and a 20-minute recovery period, was undertaken (Rosekind et al., 1994). NASA researchers studied 21 pilots during transoceanic flights 9.7 to 13.8 hours in duration, crewed by two pilots and one flight engineer. Participants in the nap group were given a planned 40-minute nap opportunity in their flight deck seats during a low-workload portion of the cruise phase of flight. One pilot rested while the other pilot and flight engineer maintained their regular duties. Pilots slept during 93 percent of these nap opportunities, took approximately five minutes to fall asleep, and slept, on average, for 26 minutes. Performance on a psychomotor vigilance task after the nap and recovery period showed improvements in median reaction time and a reduc- tion in lapses when compared to results of the control (no-nap) group.

Controlled Rest vs In-Flight Rest

In-flight rest is planned before a flight and only occurs on augmented flights crewed by three or four flight crewmembers. In-flight rest involves individual flight crew taking turns leaving the flight deck, usually for multiple hours, to rest and sleep in blocked-off cabin seats or a designated rest facility. In contrast, CR is not planned before a flight, is taken in-seat on the flight deck, and involves a short period of rest (usually about 40 minutes) during which a nap is taken.



Considerations for Using Controlled Rest

Crew should aim to have adequate sleep before flight

Controller Rest can reduce fatigue but not eliminate it

Controlled Rest shall not be used as a scheduling tool

Controlled Rest is not a means of deferring duty or extending a flight duty period

There should be a minimum recovery period of 20 minutes

While the profile of sleep inertia following CR can vary, in prior studies, performance tests were taken at 10 minutes (Rosekind et al., 1994) and 15 minutes (Valk and Simons, 1997) after the end of the rest period. In each of these studies, performance was better on average relative to the control group at the same relative time during the flight. This supports the practice of a minimum 20-minute recovery period after the end of a CR period.

Safeguard Alertness of Non-Resting Pilot

When one pilot is resting, the non-resting pilot may have difficulty maintaining alertness. Therefore, before Controlled Rest is initiated, flight crew should have an open discussion about their alertness levels, to determine whether/when it will be taken.

Use of Automation

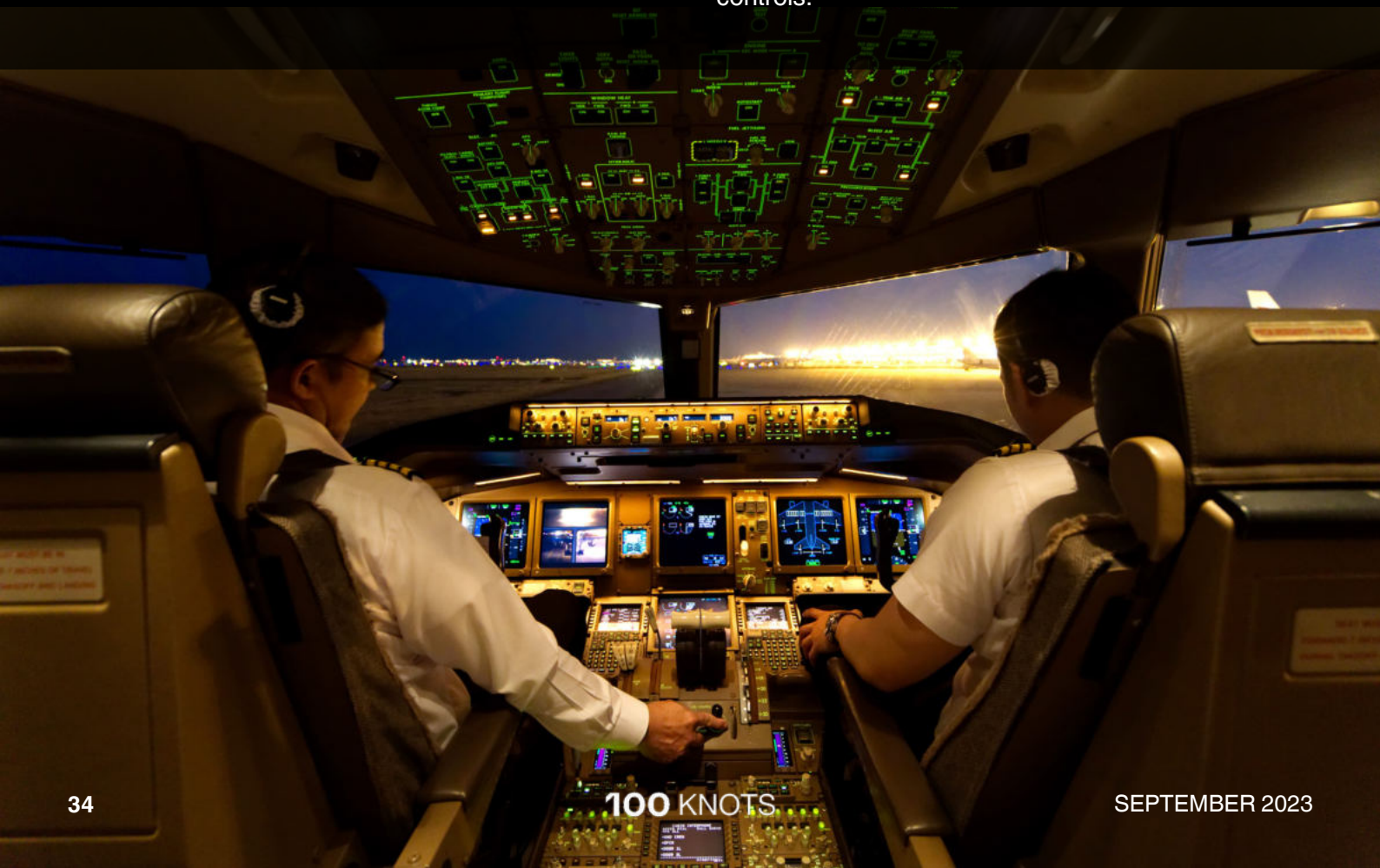
The autopilot and auto-thrust systems (if available) should be operational.

Establish Procedures

Procedures for controlled rest on the flight deck should be published and included in the Operations Manual. Controlled rest should be used on a flight sector duration of 3 hours or more (DGCA).

Secure for Interference

The harness should be used and the seat positioned to minimize unintentional interference with the controls.



Planning is Critical

The pilot in command should define criteria for when his/her rest should be interrupted. Hand-over of duties and wake-up arrangements should be reviewed. Any routine system or operational intervention which would normally require a cross check, should be planned to occur outside controlled rest periods.

Effective Monitoring & Reporting

The Fatigue Safety Action Group should be able to monitor the use of controlled rest on the flight deck to evaluate whether existing mitigation strategies are adequate. Crew reports are encouraged.

Use of Sleeping Aids

Aids such as eye shades, neck supports, ear plugs, etc., should be permitted for the resting pilot.

Beware of Sleep Inertia

The controlled rest period should be no longer than 40 minutes, to minimize the risk of sleep inertia on awakening. Controlled rest should only be utilized during the cruise period from the top of climb to 20 minutes before the planned top of descent.

Independent of FDTL

It should not be used as a method for extending crew duty periods.

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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