Civil Aviation Authority of Singapore

SINGAPORE NATIONAL AVIATION SAFETY PLAN 2025-2027

CONTENTS

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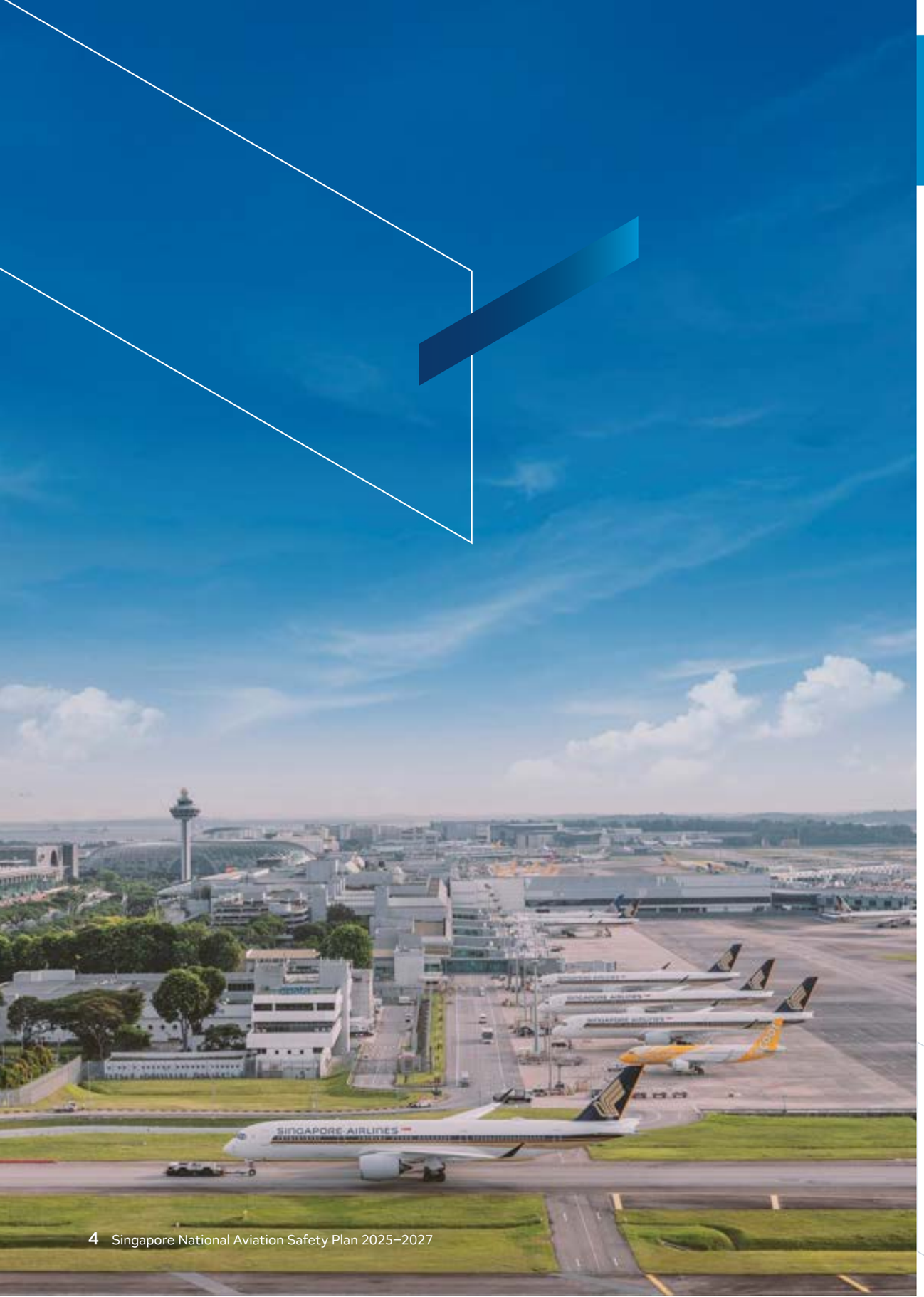


FOREWORD

Global aviation is growing strongly, with volume expected to triple over the next 25 years. As we seize opportunities, the recent spate of accidents and serious incidents around the world is a timely reminder that we must be safe to grow.

For the Civil Aviation Authority of Singapore (CAAS), aviation safety is, and will always be, a top priority. We seek to build a strong safety regime, underpinned by a strong safety culture and strong safety leadership. We believe that safety is best assured through active partnership with the 200 aviation companies and over 25,000 aviation personnel in our ecosystem.

The National Aviation Safety Plan is a joint action plan, whereby once every three years, government agencies, aviation companies and aviation personnel work together to review the operating environment, identify emerging safety risks and take coordinated actions to address them. The first National Aviation Safety Plan was released in 2022. Its focus was on the smooth and safe ramp-up of aviation manpower and operations post-COVID. I am happy to note that the Singapore aviation sector has managed to achieve a strong and full recovery.

As we position ourselves for growth, it is timely that we review the operating environment and update our plan for the next triennium. The National Aviation Safety Plan (2025–2027) brings together all aviation stakeholders to work on new emerging risks, including those associated with manpower constraints, the adoption of new technology, and Global Navigation Satellite System Radio Frequency Interference. It seeks to identify risks early and develop timely and more effective interventions through data-sharing and collaboration across all stakeholders.

I thank all our partners for working with CAAS to develop this joint action plan. It is by working together that we can best assure aviation safety for the flying public and seize the exciting opportunities that aviation brings.

Han Kok Juan
Director-General
Civil Aviation Authority of Singapore

INTRODUCTION

Purpose

Singapore's National Aviation Safety Plan (NASP) aims to strengthen aviation safety and reduce risks by outlining and implementing a national aviation safety strategy. This action plan is a key part of the State Safety Programme (SSP), which outlines Singapore's regulatory philosophy, values, processes, and safety commitments. The NASP details the safety objectives, performance metrics, challenges, strategic priorities, and actions developed by CAAS, Transport Safety Investigation Bureau (TSIB), aviation industry partners, and unions. It is a collaborative effort to address the risks and safety challenges identified by the SSP, to achieve Singapore's safety objectives.

The International Civil Aviation Organization (ICAO), through the Global Aviation Safety Plan (GASP) and other initiatives, advocates a proactive approach to managing safety and has identified global safety objectives, risk categories, and desired outcomes. In line with Singapore's commitment to enhancing safe and efficient air travel internationally, the NASP also supports the implementation of the ICAO GASP and its associated Asia-Pacific Regional Aviation Safety Plan (AP-RASP).

A safe, resilient, and sustainable aviation ecosystem supports Singapore's economic growth. In this regard, the NASP ultimately aims to enhance safety oversight, adopt a risk-based safety management approach, and foster collaboration between stakeholders within the Singapore aviation sector, as well as other States, organisations, and industries in the region.

Development and Review of the NASP

The NASP is developed in line with SSP objectives. CAAS leads the development and review of the NASP, in consultation with TSIB, aviation industry organisations, and unions, taking into consideration new or emerging risks, as well as the review of existing risks. National operational safety risks and organisational challenges are assessed and determined through a proactive hazard identification and safety risk management process. This process is managed by CAAS, which provides a source of safety intelligence. The insights gathered help to determine the areas for inclusion in the NASP.

In line with our efforts to strengthen safety collaborations throughout the Singapore aviation ecosystem, the NASP Working Group (NASP-WG) was established comprising representatives from key aviation stakeholders. The NASP-WG assists with the identification of safety challenges, development of actions, and monitoring of the NASP action implementation. The progress of their work is shared with the relevant committees under the SSP, and the wider industry through engagement sessions. This process provides assurance that improvements are continuously made to achieve our safety objectives and highlights any barriers to implementation that may need to be addressed. It also provides the basis for initiating further safety actions where necessary.

SAFETY OBJECTIVES

Singapore is dedicated to achieving the highest standards in aviation safety. We have robust and effective safety oversight, and air accident and incident investigation regimes that meet our international safety obligations under The Convention on International Civil Aviation. We strive to proactively manage safety risks and cultivate a positive safety culture within our aviation system, where every individual and organisation takes responsibility for maintaining a high standard of safety. We are also committed to providing the necessary resources and equipping our staff to perform their duties proficiently.

To this end, Singapore has established the following Safety Objectives as part of our SSP.

a) Enhance the level of safety of Singapore's aviation operations, and in particular, to maintain zero fatal accidents involving entities under its safety oversight;

b) Ensure that Singapore's aviation safety oversight and investigative regimes are effective, robust, aligned with ICAO Standards and Recommended Practices and keep pace with industry developments;

c) Ensure that hazards in Singapore's aviation operating environment are proactively identified, and related risks assessed and mitigated to as low as reasonably practicable;

d) Foster a positive safety culture and strengthen cooperation among industry stakeholders; and

e) Pursue and advocate for the enhancement of aviation safety regionally and globally.

SAFETY PERFORMANCE

Globally, aviation has become safer over the years. Statistics from the International Air Transport Association (IATA) show that the global commercial aircraft accident[1] rate has trended downwards from 2.06 per million departures in 2014, to 1.13 per million departures in 2024. The improvement in accident rate is largely due to technological advancements, improvements to safety processes, and enhancements to Safety Management Systems (SMS). Nevertheless, safety cannot be taken for granted and continued vigilance must be emphasised.

Singapore uses safety metrics to establish a clearer and more comprehensive framework for measuring the outcomes of our national aviation safety efforts, and support risk-based safety oversight and prioritisation of safety interventions. It also aligns with ICAO's emphasis on the importance of safety data sharing, which enables stakeholders to better understand the rationale behind safety interventions and their expected outcomes.

As we drive actions that seek to prevent accidents and serious incidents from recurring, it is crucial for the sector to continually seek avenues to further reduce the risk of aviation safety occurrences. To do this effectively, the sector will need to go beyond learning from past incidents and look towards adopting more avenues to identify and mitigate potential safety risks.

In this regard, our safety performance monitoring system proactively identifies potential safety issues in order to prevent accidents and incidents with more severe outcomes. Safety Performance Indicators (SPIs) are regularly reviewed, and revised where necessary, to ensure their relevance to the current operating environment and to our Safety Objectives. CAAS works with industry partners to determine whether existing measures are effective to mitigate identified safety risks.

From 2022 to 2024, there were 3 accidents involving Singapore-registered aircraft overseas with 1 resulting in a fatality, and 10 serious incidents[2] involving Singapore-registered aircraft and/or other aircraft operating in Singapore.

A summary of the accidents and serious incidents from 2022–2024 is shown in the table below.

Accidents

S/N	Date	Description
1	18 Jun 2023	A Singapore-registered Boeing 787-9 was found to be missing the left-hand wheel and axle of its nose landing gear after landing in Taipei Taoyuan International Airport.
2	21 May 2024	A Singapore-registered Boeing 777-300ER encountered turbulence in Myanmar Flight Information Region (FIR) during the cruise over the airspace near Myanmar, which resulted in one fatality and multiple injuries.
3	6 Sep 2024	A Singapore-registered Boeing 787-9 aircraft encountered turbulence in Hong Kong FIR during descent to landing, which resulted in one passenger and one cabin crew sustaining injuries.

[1] *Based on the definition of an accident in ICAO Annex 13 - Aircraft Accident and Incident Investigation.*

[2] *Based on the definition of a serious incident in ICAO Annex 13 - Aircraft Accident and Incident Investigation.*

Serious Incidents

S/N	Date	Description
1	6 May 2022	A Singapore-registered Boeing 737-800 experienced a tail strike during take-off from Kathmandu airport. The aircraft did not sustain any structural damage.
2	4 Feb 2023	A Singapore-registered Boeing 777-300ER experienced a Traffic Collision Avoidance System Resolution Advisory (TCAS-RA) in Tehran FIR with a foreign aircraft. There were no injuries or damage to aircraft.
3	2 Mar 2023	A foreign-registered Airbus A380-800 experienced a runway excursion upon landing at Changi Airport. The incident resulted in damage to two of its tyres and three runway edge lights.
4	4 Apr 2023	A Singapore-registered A320-200 aircraft experienced a tail strike during landing at Hat Yai International Airport. The aircraft sustained scuffs and abrasions on its lower fuselage near the rear of the aircraft. Part of the Emergency Locator Transmitter antenna was also damaged.
5	17 Apr 2023	A Singapore-registered Boeing 747-400 freighter experienced a high energy rejected take-off at the Jomo Kenyatta International Airport. 11 of the 16 main landing gear tyres were deflated due to hard braking.
6	10 Sep 2023	A foreign-registered Airbus A320neo experienced smoke warnings in the cockpit and cabin. The aircraft made an emergency landing at Changi Airport and initiated passenger evacuation upon stopping on the runway. Fire at the left engine tailpipe was extinguished. Nine passengers suffered minor injuries during the evacuation.
7	14 Jul 2024	A Singapore-registered Airbus A320-200 experienced in a loss of separation incident in Thailand FIR with a foreign-registered Airbus A320. There were no injuries or damage to aircraft.
8	17 Jul 2024	A foreign-registered Dassault Falcon 900EX experienced a misaligned take-off on the right edge line of Runway 03 at Seletar Airport. The aircraft continued to its destination airport where it was found with a damaged nose landing gear tire and nose landing gear auxiliary shield door.
9	19 Jul 2024	An unmanned aircraft weighing around 10kg experienced loss of control during a test flight in Singapore. The unmanned aircraft hit a building, fell to the ground, and caught fire.
10	6 Oct 2024	A foreign-registered Bombardier Global 6000 experienced a misaligned take-off on the right edge line of Runway 03 at Seletar Airport. This resulted in damage to seven runway edge lights and one taxiway edge light. After landing at its destination airport, the aircraft was found to have damage to its right main landing gear wheel assemblies and a hydraulic fluid leak from its right brake system.

There were two turbulence-related accidents that occurred in 2024, involving Singapore-registered aircraft operating overseas. One aircraft encountered severe turbulence while operating a commercial flight from London to Singapore, resulting in one passenger fatality and multiple injuries. Another Singapore aircraft encountered turbulence while descending in Guangzhou, resulting in multiple injuries.

To mitigate the risks of turbulence, Singapore air operators have implemented several measures. These include incorporating turbulence-related scenarios as part of evidence-based training for flight crew. This ensures that they are well-prepared to manage turbulence encounters. The use of modern weather radars and turbulence awareness applications also enables flight crew to avoid areas of potentially hazardous turbulence. Internationally, CAAS is working with several other like-minded civil aviation authorities to promote the use of enhanced turbulence forecasting and onboard turbulence detection systems and to share real-time turbulence data. While these mitigating actions have been effective, we recognise this as a developing safety risk area where more work can be done. Hence, there are several actions in this NASP designed to address this risk.

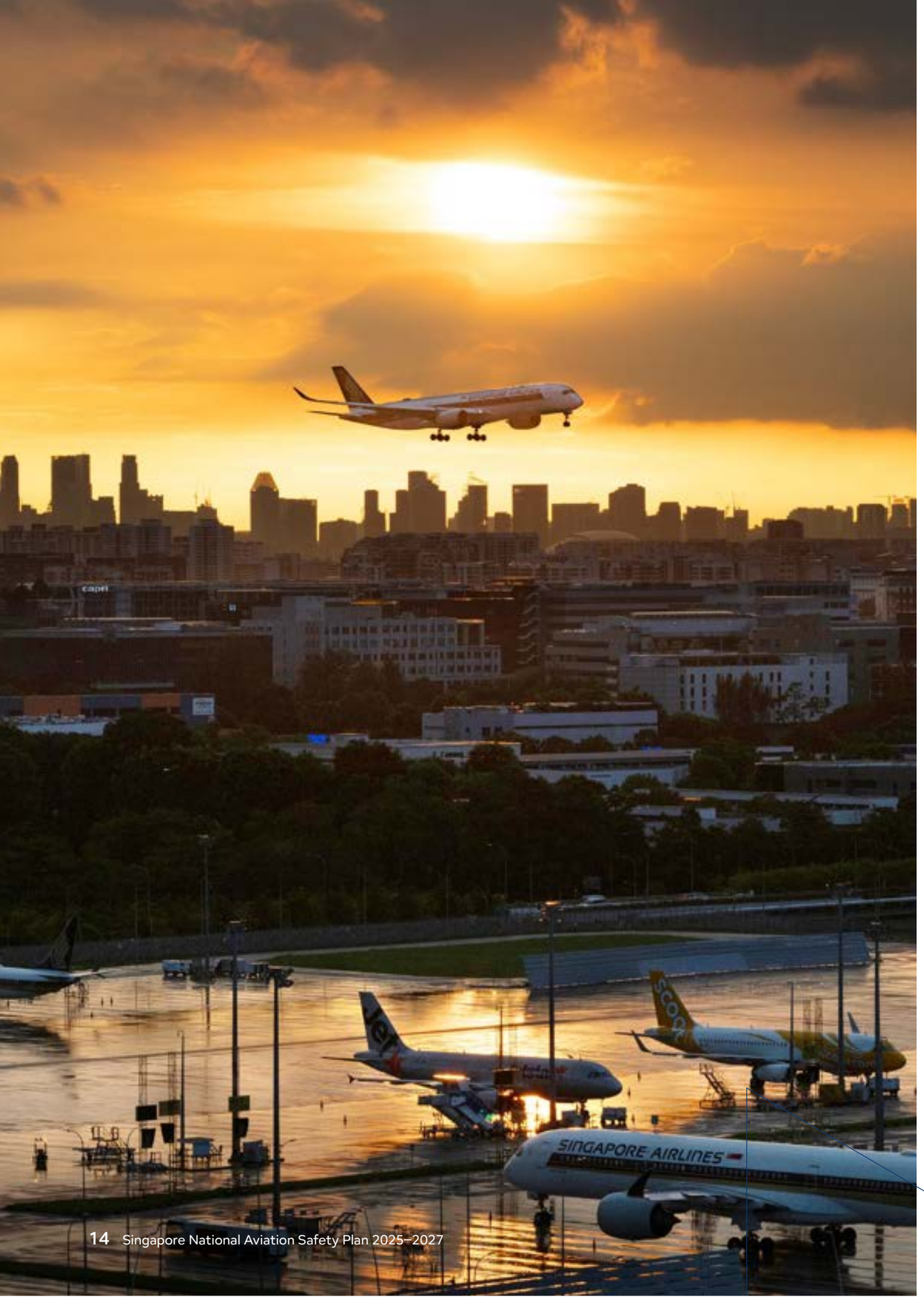
There was one accident related to a system component failure. In 2023, a Singapore-registered aircraft operating from Incheon to Taipei sustained a nose wheel detachment that was detected after landing in Taipei. While the exact cause of the damage that led to the detachment could not be determined, to mitigate the possibility of recurrence, all Singapore's air operators of the type performed a fleet-wide inspection. Additionally, Maintenance, Repair and Overhaul (MRO) organisations have taken steps to ensure their staff perform the correct and necessary actions during maintenance.

Accidents, Serious Incidents, and other occurrences are further classified using the ICAO Accident/Incident Data Reporting (ADREP) taxonomy to enable accurate trending and targeted measures to prevent future occurrences. None of the accidents were associated with the ICAO Global High-Risk Categories (G-HRCs[3]). The accidents were related to turbulence encounters and System Component Failure, which are newly recognised as other global risk categories for focus in the 2026–2028 edition of the ICAO GASP.

Associated Risk Area based on ADREP	Accidents	Serious Incidents
Loss of Control In-flight	0	1
Mid-Air Collision	0	2
Runway Excursion	0	3
Runway Incursion	0	0
Controlled Flight into Terrain	0	0
System/Component Failure	1	2
Turbulence Encounter	2	0
Abnormal Runway Contact	0	2

[3] *ICAO has identified the following Global High-Risk Categories (G-HRCs) based on actual fatalities, high fatality risk per accident or the number of accidents and incidents:*

- *Controlled Flight into Terrain (CFIT)*
- *Loss of Control In-flight (LOC-I)*
- *Mid-Air Collision (MAC)*
- *Runway Excursion (RE)*
- *Runway Incursion (RI)*



SAFETY CHALLENGES

IATA projects that air traffic in the Asia Pacific region would grow at a compound annual growth rate of 5.3%, nearly tripling by 2043. Global air passenger journeys in 2050 could exceed 10 billion. The rapid growth and rising demand for air travel, as well as changes to the operating environment, will inevitably place additional stress on the system, with aviation personnel and systems under pressure to keep up high levels of operational throughput to meet demand. The confluence of these factors would result in an increase in safety risk if not adequately mitigated.

While Singapore maintains a strong aviation safety regime, the sector continues to face both existing and new challenges that require constant vigilance. This section outlines some of the key safety challenges that we expect to face, and manage, in the coming years.

Operational Safety Risks

State-level risks and precursor events

Singapore has established State-level safety risks comprising ICAO G-HRCs, and additional risks identified to be of relevance to our local aviation industry through our Safety Data Collection and Processing System (SDCPS). They are:

1. Runway Incursion
2. Runway Excursion
3. Mid-Air Collision
4. Loss of Control In-flight
5. Controlled Flight into Terrain
6. System Component Failure or malfunction
7. Ground occurrences resulting in damage
8. Severe turbulence encounters

We will continue to maintain focus on monitoring and identifying these operational risks. Precursor events and trends are also closely monitored by CAAS and industry so that mitigating measures can be developed early if necessary. For example, Global Navigation Satellite System Radio Frequency Interference (GNSS RFI) events are precursors to Controlled Flight into Terrain, Mid-Air Collision, and Loss of Control In-flight, while taxi errors are potential precursors to Runway Incursions and ground collisions. Some other examples of occurrences that we are continuously analysing include Traffic Collision Avoidance System Resolution Advisory (TCAS-RA) alerts, system component failures, and adverse weather events including turbulence encounters.

Emerging Risks

Increasing air traffic density

Meeting the increased aviation demand projected for Singapore and the Asia Pacific region will require improved handling capacities, efficiency, and productivity. Increased air travel will introduce greater complexity as the physical airspace volume remains constant, and resources are challenged to grow in tandem with traffic volume. Resultant safety risks can increase, including the potential for conflicts that compromise safety margins.

Global supply chain disruptions

Global supply chain disruptions and delays in production of aircraft parts have also put significant pressures on maintenance organisations and aircraft operators, including keeping ageing fleets in service for longer and seeking alternative solutions to maintain operational capacity. An example of this is extensions to repair intervals, which while provided for, can increase risk exposure and the possibility of multiple system failures if used excessively. The sourcing for alternative suppliers and distributors has also surfaced risks of malicious actors supplying unapproved aircraft parts with forged credentials.

Operations affected by conflict zones

Geopolitical conflicts give rise to operational disruptions, and flights near conflict zones bring heightened safety risks. Operators will need to make regular safety assessments of flight routes. Military operations around conflict zones have also resulted in an increase in GNSS RFI, which, while not targeting commercial aviation, still disrupts communication and navigation capabilities of aircraft and Air Navigation Service Providers (ANSPs).

Manpower and resource challenges

Manpower and resource constraints may inadvertently exert pressure on organisations as they grapple with rising operational demands. A newer, less experienced workforce combined with the retirement of senior personnel may also result in a loss of expertise and a weakened safety culture. In addition to maintaining sufficient manpower and resources, it will be important to promote training, experience sharing, knowledge management, open reporting of occurrences, and a strong positive safety culture, to maintain safety standards.

Fatigue risk management

Increased operational demand will also place pressure on airlines and ANSPs to roster flight crew or Air Traffic Control Officers (ATCOs) more efficiently or frequently, close to regulatory limits. While prescriptive limits may be complied with, this can nonetheless increase fatigue risks, which research has shown has a significant impact on flight crew and controller performance and a consequential increase in the risk of safety occurrences. Open reporting of fatigue, and a tripartite effort between unions, service providers, and the regulator, will help ensure that rostering practices do not unduly introduce fatigue risk. These should also be supported by safety promotion and education on fatigue risks, and encouraging performance-based fatigue risk management systems.

Non-compliance and unacceptable behaviours

Challenging working environments, extended and/or irregular working hours, unserviceable equipment, time pressures, and inadequate resourcing may lead to procedural creep and an increase in the risk of corner-cutting. Inadvertent non-compliance such as errors, slips, and lapses may also increase. We will seek to improve systemic quality assurance, strengthen positive safety cultures that promote personal commitments to safety, and encourage proactive safety management and the application of positive safety culture principles.

New and Emerging Technologies

Evolving systems and change management

New technologies and automation in aviation systems are necessary to increase operational efficiency. However, the interplay between human performance, systems, and procedures will need to be considered and managed carefully to mitigate the risk of introducing inadvertent safety issues. New infrastructure and systems should be designed with the human in mind. For instance, Changi Airport's new Terminal 5 and the next generation of Air Traffic Management (ATM) systems will require familiarisation by aviation personnel with the new concepts, infrastructure, systems, and processes involved. Further on the horizon, there may also be new entrants into the airspace such as Unmanned Aircraft Systems (UAS) and cross-border Advanced Air Mobility (AAM) aircraft.

Ensuring the safe and seamless integration of new systems will require thorough safety assessments, proper certification processes, and careful consideration of human factors, ensuring that aviation personnel are well-prepared and supported in adapting to these changes. As new systems become increasingly inter-connected and reliant on digital interfaces, it would be beneficial for aviation personnel to have a system-level knowledge of critical infrastructure. This would equip them to better understand the potential implications of system failures and the interplay between different technological components, to effectively resolve technical issues that may compromise aviation safety.

Safety oversight and regulatory capabilities

New technologies will develop ahead of regulatory standards and certification, and innovative solutions will be necessary to ensure that such advancements can be supported while the necessary regulations are developed. Regulators will need to ensure that safety oversight personnel have the required expertise to comprehensively understand, evaluate, and regulate these innovations in a timely manner. Regulators will also have to adapt, enhance their capabilities, and maintain collaborative relationships, to effectively assess and manage the safety implications of emerging technologies, and ensure that the advancements in aviation continue to prioritise safety and operational integrity.

Risk of over-reliance on automation

Increasing automation of aircraft systems reduces the need for human intervention, thereby reducing human error, increasing efficiency, and achieving cost benefits. However, new risks may also be introduced, such as complacency, reduced situational awareness, and a degradation of crucial skills among both flight crew and ATCOs – particularly critical during system malfunctions or emergencies. We need to ensure personnel are supported in adapting to new systems, and that new technologies are introduced safely, supported by safety assessments, training, and human factors considerations.

Artificial Intelligence (AI) and integrated technologies

While many of these technologies are still at the nascent stage of development, there are some current examples of partial implementation. AI is being used in safety data systems in some countries to categorise safety occurrences and facilitate analysis. However, the rapid evolution of AI technologies may pose challenges for regulators in establishing and enforcing standards for their safe and effective use in aviation. Greater efforts are necessary to understand their potential use cases and the associated safety impact.

STRATEGIC PRIORITIES

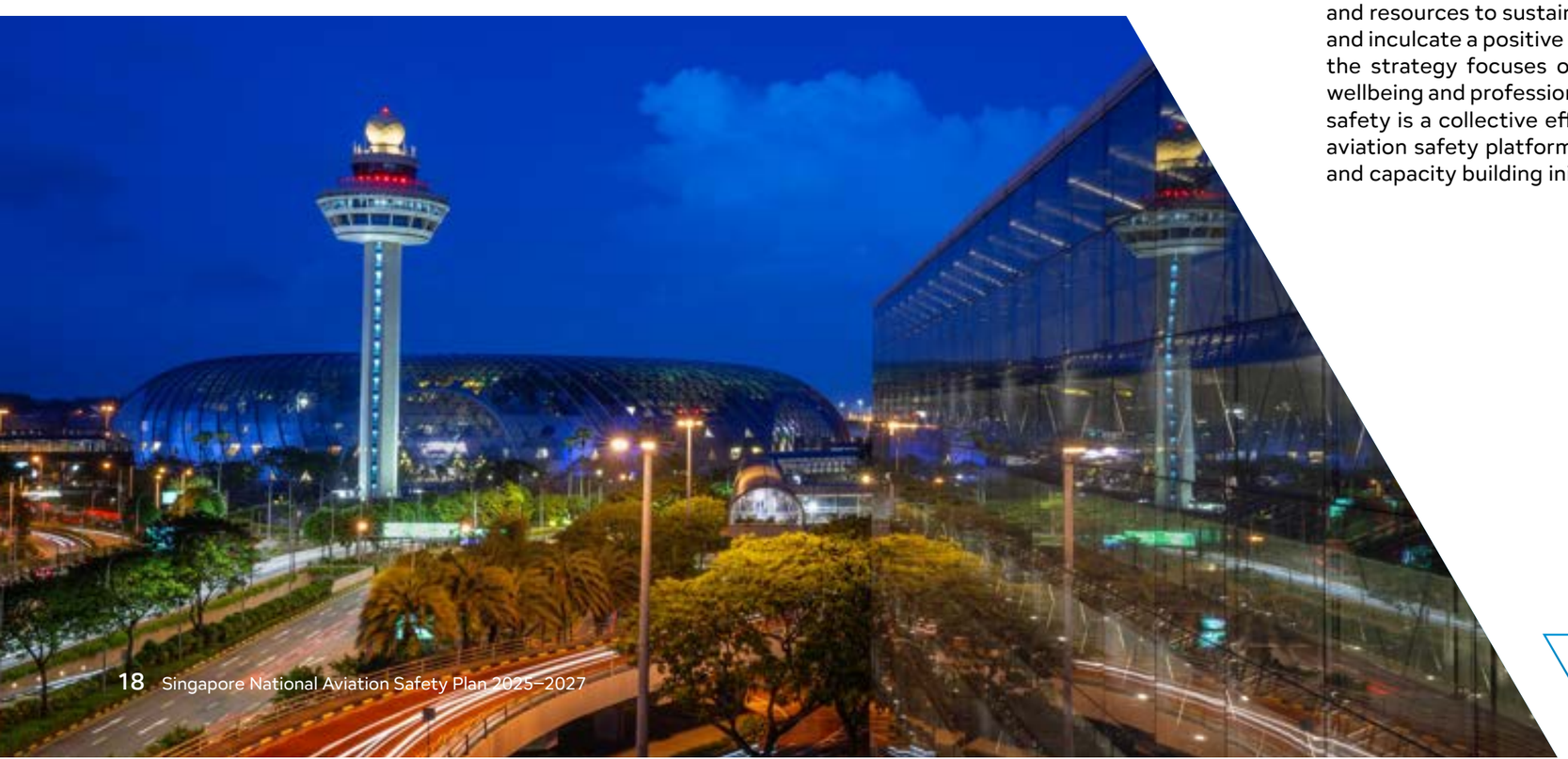
The NASP outlines four strategic priorities that will continue to anchor the development of safety actions for the next triennium.

Enhance Operational Safety

Singapore's operational safety enhancement strategy encompasses a comprehensive range of initiatives focused on strengthening aviation safety across multiple domains. Examples include infrastructural improvements, safe integration of new aircraft and systems, and proactive risk management. This ensures that as the aviation sector grows, safety standards are not just maintained but further enhanced through improved monitoring systems, better communication protocols, and advanced technological solutions.

Review and Develop Policies and Rules

A strong and progressive safety regulatory regime facilitates safe and resilient aviation operations. CAAS aims to develop regulations that provide clear direction to the aviation industry and are in line with international standards and best practices. To this end, we also adopt an inclusive and collaborative approach by engaging the aviation industry in the development of policies and processes. This approach aims to facilitate industry growth and innovation, while ensuring safety standards are not compromised.



Strengthen Safety Management and Safety Culture

A proactive and holistic approach to safety management, taking into consideration technical, human, organisational, and total system factors, will be crucial in adapting to evolving operational challenges. This includes a data-driven approach to identify precursors and risks in a timely manner, as well as the establishment of technical working groups and specialised taskforces to address emerging challenges and supporting the industry in strengthening and assessing their own SMS. This will be complemented by initiatives to foster a sector-wide strong and positive safety culture through stakeholder engagement, tripartite collaboration, and targeted safety awareness programmes. CAAS will also ensure continued dialogue and outreach through our existing safety promotion channels, such as the Aviation Safety Forum, CAAS Safety Series seminars, and *The Leading Edge* publication. Through these coordinated efforts, we will work to ensure that participants in the Singapore aviation sector, from organisations to individuals, remain vigilant and committed to upholding aviation safety.

Develop Human Capital

CAAS is committed to support the aviation industry in maintaining a pipeline of skilled manpower and resources to sustain safe operations. It is important to promote training, knowledge transfer and inculcate a positive safety mindset among new entrants and leadership personnel. At its core, the strategy focuses on three pillars: enhancing technical capabilities, supporting workforce wellbeing and professional development, and fostering strategic partnerships. Given that aviation safety is a collective effort, we also remain committed to supporting regional and international aviation safety platforms, such as the annual Asia Pacific Summit for Aviation Safety (AP-SAS), and capacity building initiatives in collaboration with ICAO and other international organisations.

ACTIONS

In line with our Strategic Priorities, the following action plan will guide the safety developments of the Singapore aviation sector for 2025–2027.

A. Operational Safety Enhancements

B. Policies and Rules

C. Safety Management and Safety Culture

D. Human Capital Development

A. Operational Safety Enhancements

Singapore is committed to reducing operational safety risks to as low as reasonably practicable. This section highlights efforts to address aviation safety occurrences and precursors, as well as enhancements that build upon existing regulatory oversight efforts.

Aerodrome

A.	Action	Completion	Lead
1.	**Conduct holistic independent review of runway safety in Singapore** Recent global trends in runway incursions and excursions have underscored the need to further strengthen runway safety efforts. As the air traffic volume in Singapore grows, additional pressure on existing runway safety defences will be tested. A comprehensive safety review of existing policies, procedures, defences, and mitigations will help to identify any weaknesses so that they can be addressed early.	2026	CAAS, CAG, RSAF
2.	**Certify and ensure safe implementation of new infrastructure and airfield systems** As airports in Singapore continue to develop and expand, there is a need to ensure that all new infrastructure and systems are designed, developed, installed, and operated in a safe and effective manner. Examples of such infrastructure include aerodrome lighting, taxiway guidance signs, and aircraft docking guidance systems. Areas that will undergo development in 2025–2027 include Changi East, West, and Changi Creek, and efforts include the certification of new aircraft stands and taxiways.	2027	CAAS

A.	Action	Completion	Lead
3.	**Ensure safe implementation of three-runway operations** To prepare for the operationalisation of the three-runway system in the next five years, CAAS will work with the aerodrome operator to conduct a safety risk assessment, as well as to verify the compliance status of the runway in line with requirements for civil, electrical, visual aids, operational and maintenance aspects – as stipulated in our regulations.	2027	CAAS, CAG
4.	**Launch efforts to reduce risks posed by wildlife to the airport environment** Wildlife strikes pose a significant threat to aviation safety, as birds or other animals colliding with aircraft may cause operational disruptions, and critical system failure. As air traffic continues to grow, so does the likelihood of wildlife encounters, making it imperative to review existing mitigation strategies, as well as explore the implementation of new initiatives, to safeguard aircraft operations.	2025	CAAS, CAG
5.	**Study the safety impact of solar panel implementation at the airfield** CAAS and CAG are working to increase solar power deployment at Changi and Seletar Airports, by studying the feasibility of airfield solar panel deployment. The parties have to ensure that the airfield solar panel implementation will not adversely affect the safety and efficiency of airport operations.	2027	CAAS, CAG

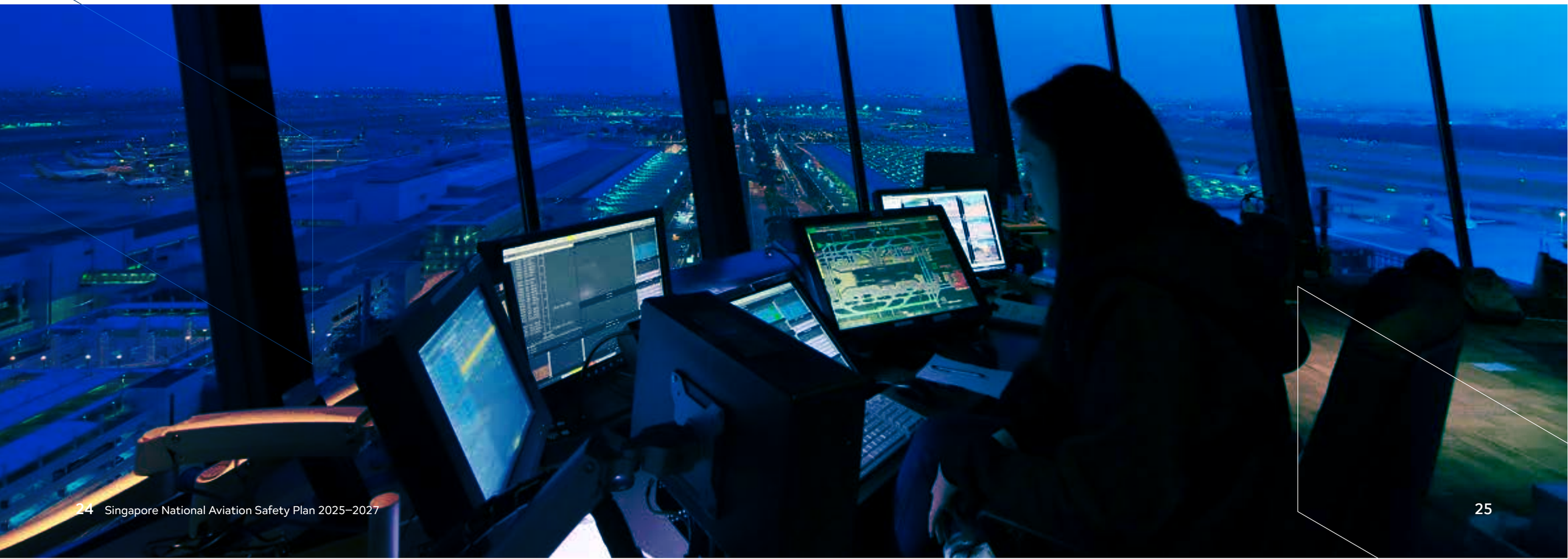
Air Operators

A.	Action	Completion	Lead
6.	**Enhance cabin safety in the areas of turbulence management, evacuation control, and managing disruptive passengers** Recent incidents, such as ground collisions and turbulence occurrences, have highlighted the crucial role of cabin safety efforts in ensuring the well-being of passengers onboard, especially as air travel demand increases. One area is aircraft evacuation. The safe conduct of an aircraft evacuation is critical to minimise injuries and fatalities during serious incident and accidents. Important lessons can be learned from effective evacuations that were conducted with few or no injuries. Further studies are necessary to understand the contributing factors that lead to unsafe behaviours, such as passengers retaining cabin baggage during evacuations. There is also a need to better understand how to improve the implementation and effectiveness of existing mitigations. These include passenger safety briefing videos, safety demonstrations, passenger announcements, safety information cards, and crew training.	2027	CAAS, AOC holders
7.	**Implement safety strategies to improve communication between aerodrome and airspace users** Misunderstanding and miscommunication pose safety risks to aerodrome and airspace users. In response to regional occurrence trends of such communication errors, proactive measures should be taken to ensure that the hazards associated with voice communication are adequately identified and mitigated.	2027	CAAS, AOC holders
8.	**Launch efforts to reduce the incidence of errors during aircraft taxi operations** Aircraft taxi errors refer to any deviations from planned taxi routes, clearances, or procedures. While the vast majority of such errors are minor and do not compromise aircraft safety, there remains a need to reduce these occurrences as they are potential precursors to more serious incidents, such as runway incursions. CAAS will continue working with our industry stakeholders to identify and assess a range of new initiatives aimed at reducing taxi errors.	2027	CAAS, CAG, AOC holders, Unions

A.	Action	Completion	Lead
9.	**Leverage regional collaborations to enhance safe operations of foreign operators** The Association of Southeast Asian Nations (ASEAN) Foreign Operator Safety Assessment (AFOSA) is a key safety initiative under the ASEAN Transport Strategic Plan. The objectives of AFOSA are to assess the safety compliance of foreign operators in the ASEAN region, establish and maintain a high uniform level of civil aviation safety standards, and enhance the safety oversight capability and capacity of civil aviation authorities within ASEAN Member States. To achieve AFOSA objectives, Singapore will work with partner civil aviation authorities to drive the harmonisation of ramp inspection standards on foreign operators and increase sharing of safety information among ASEAN Member States.	2026	CAAS
10.	**Ensure the safe entry of new aircraft types, such as the B777-9 and A350F** CAAS works with local AOC holders to ensure the safe induction of any new aircraft type. CAAS will also develop and maintain system level knowledge of new entrants that are likely to commence operations in Singapore in the coming years.	2027	CAAS, AOC holders

Air Navigation Services / Airspace

A.	Action	Completion	Lead
11.	**Deepen collaboration between shared airspace users** Communication and collaboration are essential for managing safety among the many users of Singapore's limited domestic airspace. As traffic grows there will be an increased need to pre-empt, identify, and mitigate any potential conflicts. Through established collaborative safety teams, we will bring together key individuals from the RSAF, safety regulator, and the ANSP to help manage these issues.	2025	CAAS, RSAF
12.	**Enhancing meteorological information accuracy to mitigate adverse weather risks** Incidences of severe adverse weather affecting flight operations are increasingly common. As traffic density increases, the rate of these incidents is expected to grow. Adverse weather represents a significant safety hazard to flight and ground operations. A key mitigation is equipping flight crew, ATCOs, and ground personnel with timely weather information that represents the present conditions and future forecasts with a high degree of accuracy. To achieve this, it is necessary to enhance the accuracy of weather models, explore innovative technological solutions, strengthen the means of disseminating information, improve real-time monitoring, and develop robust system contingency.	2028	CAAS, MSS, CAG



A.	Action	Completion	Lead
13.	**Establish a taskforce to study the effects of GNSS RFI and drive the implementation of further mitigations** GNSS RFI is a widespread issue that is intensifying globally. GNSS supports numerous aircraft systems including primary navigation functionality, terrain awareness systems, automatic position reporting, Traffic Collision Avoidance System (TCAS), communications, and on-board time monitoring. Most serious GNSS RFI events occur in the vicinity of conflict zones, but the impacts can affect wide regions. The effects can result in loss of situational awareness, loss of separation, or even controlled flight into terrain. GNSS RFI can also have an impact on air traffic control's ability to maintain separation between aircraft. While there is currently no technological solution available, it is crucial to detect, report, and safely managing GNSS RFI through regional collaboration and the development of robust procedures.	2025	CAAS
14.	**Conduct a holistic review of Performance Based Navigation (PBN) implementation** PBN enhances aviation safety through precise aircraft positioning and standardised flight paths. It reduces navigational errors, improves airport accessibility in challenging conditions, and enables better traffic separation while decreasing pilot and controller workload. As PBN specifications continue to evolve and air traffic volumes increase, existing flight procedures will be reviewed to enhance air navigation, and mitigate traffic bottlenecks and safety hazards.	2026	CAAS
15.	**Develop an Unmanned Aircraft Traffic Management System (UTMS)** The UTMS will provide an integrated, one-stop portal for regulatory services such as the Unmanned Aircraft (UA) operator and UA registrations, flight approvals, and enable the tracking of all UA operations in Singapore to ensure aviation and public safety and security. CAAS is working with relevant government agencies to review and streamline UA regulatory processes and to develop the UTMS.	2027	CAAS

Related SSP Safety Objective(s):	• Enhance the level of safety of Singapore's aviation operations, and in particular, to maintain zero fatal accidents involving entities under its safety oversight. • Ensure that hazards in Singapore's aviation operating environment are proactively identified, and related risks assessed and mitigated to as low as reasonably practicable.
Related GASP Goal(s):	• Goal 1: *Achieve a Continuous Reduction of Operational Safety Risks*

B. Policies and Rules

A robust and progressive aviation safety regulatory regime supports safe operations. This section highlights the key policy and rule reviews, as well as regulatory framework enhancements, to strengthen the regulatory regime and enable or encourage enterprise and innovation.

B.	Action	Completion	Lead
1.	**Launch a tripartite committee to collaboratively enhance fatigue risk management practices, regulation, and safety oversight** The post-COVID-19 surge in demand for air travel had led to higher operational demand on our aviation professionals who keep the aviation system running to serve the travelling public. For example, flight crew are flying closer to the allowable flight duty limits. It is pertinent to pay closer attention to fatigue risk management. Collaboration amongst tripartite stakeholders is critical to ensure holistic consideration and facilitate alignment of stakeholders to uphold safety in operations while supporting growth in air travel. Through the tripartite collaboration, we will also continually refine our regulations in a timely manner to be fit-for-purpose and reduce regulatory uncertainty if any.	2025	CAAS, AOC holders, Unions
2.	**Strengthen the Transport Safety Investigations (TSI) Act to enhance protection of information** Cockpit Voice Recorder (CVR) data is important evidence for TSIB in the course of an investigation. However, pilots may have concerns that the data could be misused for purposes other than safety investigation. The TSI (Act) will be reviewed to enhance the protection of CVR data, including after an investigation is completed, to provide greater assurance.	2027	TSIB
3.	**Enhance and modernise regulatory rules to facilitate safe industry growth** To support the safe growth of the aviation sector, it is necessary for regulations to be modernised to keep pace with emerging markets, new technology, and manpower requirements. Regulations that will be modernised include those pertaining to unmanned aircraft, electrical vertical take-off landing (eVTOL) operations, flight simulation training devices, aviation training organisations and licensing for flight crew, UA operators, authorised flight examiners, and ATCOs.	2027 and beyond	CAAS
4.	**Develop resource documents about regulatory approaches for emerging technologies and issues** In view of rapid technological development and advancements in the aviation sector, there is a need to provide clarity to both industry stakeholders and the public on how Singapore's aviation safety regulatory framework accommodates innovation while maintaining robust safety standards. To address this, CAAS will develop resource documents on our regulatory approach to new technologies and the considerations behind striking such a balance.	2026	CAAS

B.	Action	Completion	Lead
5.	**Develop safety regulatory framework for autonomous vehicles at the airside** To manage manpower challenges and improve operational productivity at the airside, CAG and ground handling companies are conducting trials of different Autonomous Vehicle (AV) types at the airport. CAAS is working on a safety regulatory framework on AVs to help facilitate the safe operations of AVs at the airside.	2025	CAAS
6.	**Develop guidance to aid air operators' compliance with operator's responsibilities in the carriage of dangerous goods** CAAS will develop new guidance emphasising the critical responsibilities of air operators in the handling and carriage of dangerous goods and elaborating on the associated hazards and potential consequences of non-compliance.	2025	CAAS
7.	**Jointly develop Asia-Pacific reference materials to facilitate operations of eVTOL and UAS** Given the rapid advancements in technology, regulators and regulations would need to keep pace with technology to reap its full benefits while ensuring public and aviation safety, and security. In response to these developments, civil aviation authorities from Asia-Pacific States are jointly developing a set of reference materials to facilitate operations of eVTOL aircraft and UAS.	2025	CAAS
8.	**Review existing regulations, incorporating the recommendations from the Asia-Pacific Reference Materials** Following the completion of the Asia-Pacific Reference Materials, CAAS will review existing regulations to incorporate recommendations, as necessary.	2027	CAAS

Related SSP Safety Objective(s):	• Ensure that Singapore's aviation safety oversight and investigative regimes are effective, robust, aligned with ICAO Standards and Recommended Practices and keep pace with industry developments.
Related GASP Goal(s):	• Goal 2: *Strengthen States' Safety Oversight Capabilities*

C. Safety Management and Safety Culture

Singapore's regulatory philosophy in aviation safety has evolved over the years to emphasise compliance and proactive risk identification and mitigation. This section highlights the key enhancements to safety management and efforts to foster a strong and positive safety culture underpinned by strong safety leadership.

Safety Culture

C.	Action	Completion	Lead
1.	**Deepen collaboration with the industry to reinforce safety mindsets to strengthen safety culture** CAAS will work closely with companies and unions to reinforce a safety mindset among operational workers, such as through more ground outreach sessions emphasising the importance of vigilance and voluntary safety reporting. CAAS will also collaborate with the industry to motivate good safety behaviours by focusing more on the positives, and recognising positive safety efforts more prominently on CAAS' and industry safety promotion platforms.	2027 and beyond	CAAS, Industry, Unions
2.	**Roll out initiatives aimed at improving alignment between management and operational personnel to strengthen safety culture** CAAS will work with the industry to develop best practice guidance on aviation safety investigations. This aims to facilitate alignment across the sector on how certain aspects of safety investigations are managed and to perpetuate good practices. This guidance would serve to support a positive safety culture. CAAS will also conduct biennial sector-wide surveys to facilitate longitudinal analyses of safety culture aspects and development of necessary interventions.	2027	CAAS, Industry, Unions
3.	**Collaborate with industry to develop future safety leaders** Safety leadership is crucial to ensure operational personnel receive the proper support and resources to carry out their work safely, balanced against operational demands. By cultivating a culture that places a strong emphasis on safety, leaders ensure that personnel are empowered to make decisions that prioritise the safe execution of operations. CAAS will explore developing a safety leadership programme, aimed at individuals joining management positions for the first time or those moving into positions of SMS leadership from other management positions.	2026	CAAS, Industry

C.	Action	Completion	Lead
4.	**Establish a CAAS authority-level safety committee to facilitate an independent perspective on aviation safety enhancement** Regulator-industry partnerships are crucial to advancing safety, in order to stay ahead of emerging issues, develop or scale up solutions, build consensus, and encourage implementation. Establishing an authority-level safety committee of experts from across the ecosystem will support the development of safety mitigations for emerging risks or new technologies that take into account the considerations and expertise of both regulator and industry.	2025	CAAS, Industry
5.	**Develop initiatives to strengthen safety awareness among airside workers** As pressure grows to meet increased demand, it is essential to maintain aviation safety as a top priority. This includes continued engagement with airside workers to ensure safety procedures are followed. It is also important to clearly communicate what constitutes acceptable behaviour and safe practices.	2026	CAAS, CAG
6.	**Improve sharing and communication between key airport operational stakeholders** Aviation operators need to work closely to address latent and emerging issues. Some matters affecting local operators may have sensitivities that need to be addressed in a more secure environment to facilitate the open sharing of data. CAAS will form a Collaborative Safety Team (CST) with Singapore operators and service providers to provide such a platform to discuss issues or hazards that affect operations. This would enable collaborative risk mitigation informed by data from incident and accident reporting, and establish double-looped learning and decision-making from active feedback channels.	2025	CAAS, Industry

Safety Management

C.	Action	Completion	Lead
7.	**Establish an Accountable Manager Safety Leadership Programme** The accountable manager for safety role must be held by C-level executives within safety critical industry organisations such as airlines, maintenance organisations, and training providers. The accountable manager is responsible for safety leadership, cultivating trust, driving accountability, promoting safety culture through active engagement, and strategically influencing the workforce to achieve organisation safety goals via a top-down approach to safety. The programme will be designed for C-suite executives in the aviation industry who will assume the critical role of accountable manager within their organisation.	2026	CAAS
8.	**Implement enhanced SMS assessment programme and engage international partners to exchange feedback for the continuous enhancement and mutual recognition of SMS assessment results** CAAS has made enhancements to its SMS assessment tool through the identification and incorporation of SMS best practices and development of outcome-based assessment criteria. These enhancements enable service providers to better understand CAAS' expectations of an effective and mature SMS, while empowering CAAS to define and assess the status of SMS implementation by service providers under its regulatory purview. The tool also ensures a comprehensive balance of compliance-based and performance-based descriptors, enhancing the efficacy of SMS assessment across domains. Following trials of the enhanced assessment methodology on selected industry organisations, CAAS will launch the enhanced assessment on a sector-wide basis, and continue to refine it. An associated course under the Singapore Aviation Academy (SAA) will be launched for our local aviation industry, following which we would like to share our efforts and learning points with international partners for them to consider adapting it for their own contexts, as well as to benchmark and coordinate with other States on their SMS surveillance requirements.	2026	CAAS
9.	**Enhance training on SMS implementation in line with new approach** As the SMSes across the sector continue to mature over the years, an enhancement of the SMS assessment methodology will better serve the sector in providing room to strengthen implementation.	2025	CAAS, Industry

C.	Action	Completion	Lead
10.	**Explore more holistic or Integrated Risk Management (IRM) approaches in aviation safety** IRM in aviation safety refers to the comprehensive and systematic approach to identifying, analysing, and mitigating risks across various areas. IRM aims to provide a holistic understanding of potential hazards and their interconnected impacts so that organisations can more effectively prioritise resources and implement preventive measures. As IRM is an emerging concept that is still being studied internationally, CAAS will monitor these international developments to assist our industry in adopting the associated holistic safety management approaches in the future, including nurturing collaboration and developing guidance where necessary.	2027	CAAS
11.	**Develop a framework for the consolidation of additional safety data sources to strengthen our analysis and mitigation of safety risks** To strengthen our safety systems and proactive risk identification, we will expand our existing safety data sources to include enhanced real-time flight monitoring, maintenance records, and incident reporting systems. This will expand our ability to identify emerging trends, conduct deeper root cause analyses, and implement more targeted safety measures.	2026	CAAS, Industry
12.	**Develop strategy for the safe adoption of emerging technologies including machine learning, AI, automation, and autonomy** Advanced emerging technologies, such as AI, represent an important opportunity to enhance manpower efficiency by helping to identify, analyse, manage, and mitigate the current safety challenges we face, as well as automate certain processes. However, such technology must be adopted in a controlled manner to avoid the introduction of new unintended risks. We will seek to establish a common understanding of the types of technology, ecosystem competency with safe usage, and set markers and goals for safe implementation.	2027	CAAS

C.	Action	Completion	Lead
13.	**Develop forensic, data-informed techniques to enhance safety risk management** More detailed analyses of past aviation events and operational data, combined with real-time information, safety reports, and aviation experts' insights, can enable us to better understand why and how risks emerge. Developing a data-informed approach or framework will support more systematic and proactive ways to identify potential risks early and implement targeted mitigations to prevent serious occurrences.	2027	CAAS
14.	**Review and enhance emergency preparedness efforts to safeguard sector in case of disruptions** As we continue to grow and evolve, the aviation sector remains vulnerable to global disruptions such as natural disasters, pandemics, aircraft incidents and accidents, which in turn give rise to complex aviation safety challenges. These safety challenges have the potential to impact our critical infrastructure, our personnel, and our passengers. The aviation ecosystem must continually adapt and develop the capability to manage the operational consequences and ensure that the highest standards of operational safety are maintained. By reviewing protocols, enhancing manpower competency, and strengthening our emergency preparedness approaches, we seek to continuously learn from previous experiences to build more effective responses to future disruptions.	2027	CAAS, Industry

Related SSP Safety Objective(s):	• Ensure that hazards in Singapore's aviation operating environment are proactively identified, and related risks assessed and mitigated to as low as reasonably practicable. • Foster a positive safety culture and strengthen cooperation among industry stakeholders. • Pursue and advocate for the enhancement of aviation safety regionally and globally.
Related GASP Goal(s):	• Goal 1: *Achieve a Continuous Reduction of Operational Safety Risks* • Goal 3: *Establish and Manage State Safety Programmes (SSP)* • Goal 4: *Strengthen Collaboration at the Regional and National Levels to Address Safety Issues*

D. Human Capital Development

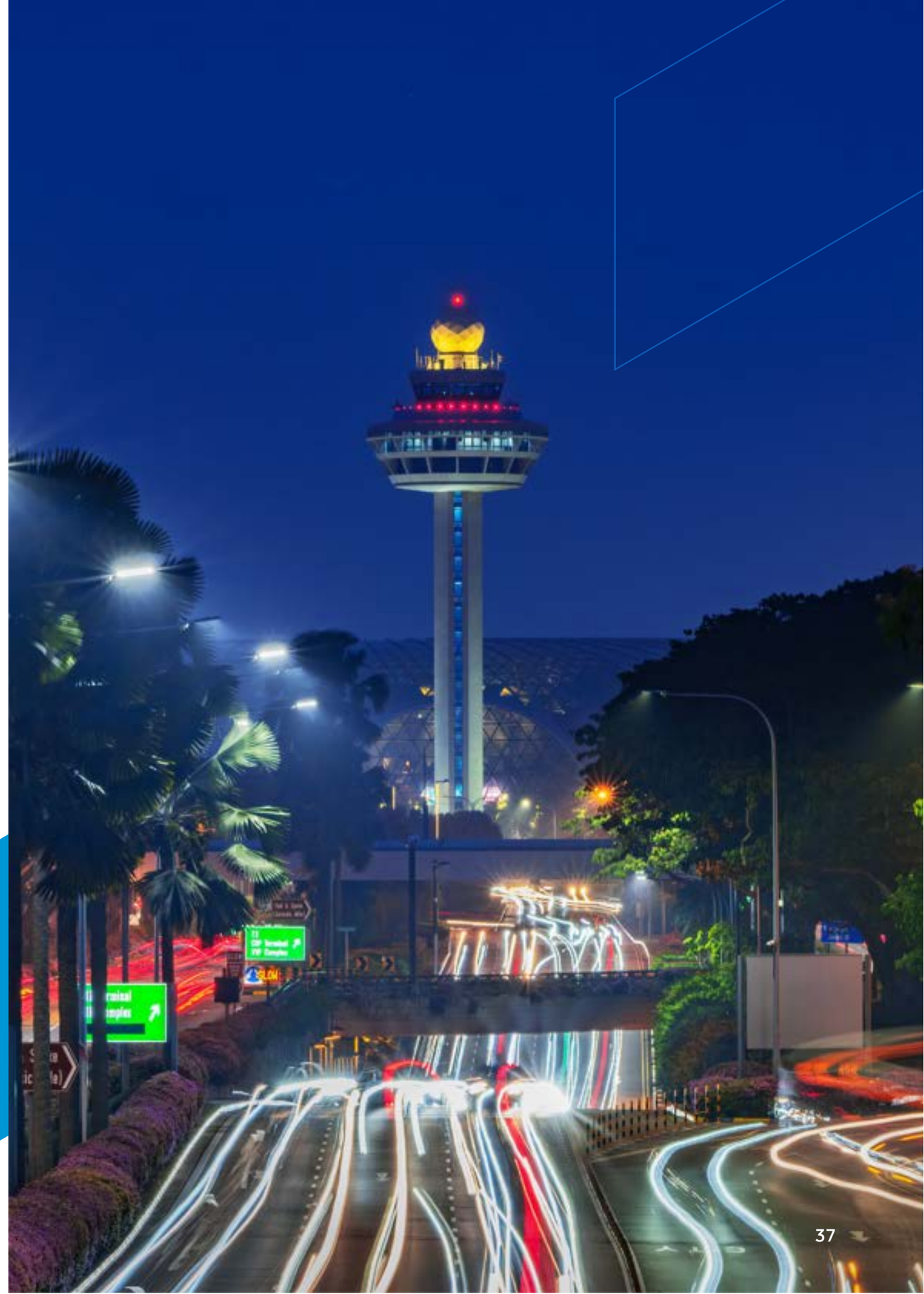
This section highlights the key efforts that Singapore will undertake to facilitate capacity building and collaboration by building technical capabilities, supporting workforce development, and fostering strategic partnerships.

D.	Action	Completion	Lead
1.	**Enhance the effectiveness and reach of mental health support initiatives within the aviation community** With the anticipated rise in operational complexities and workload demands in the aviation sector, the mental health and wellbeing of aviation professionals requires closer attention. These challenges are further compounded by increasing psychosocial stressors in society. Greater support is needed to help aviation personnel cope with the evolving work-life environment. This will enable them to continue performing their duties effectively, productively, and safely. The Tripartite Mental Health and Wellness Support Framework for Pilots and Air Traffic Controllers was launched successfully in March 2023, and served as a useful platform to continue the collaborative and coordinate efforts to improve mental health support for our pilots and air traffic controllers. CAAS and Changi General Hospital will deepen its partnership and facilitate access to professional resources, to help our aviation stakeholders establish mental health and wellbeing support programmes and peer support networks for their workers. Industry stakeholders will also be encouraged to continually review their environments for areas needing attention and formulate action plans to implement new initiatives or widen the reach of existing ones.	2027	CAAS, CGH
2.	**Develop community-level initiatives to support our airside professionals in the areas of career development and skills upgrading, job redesign to incorporate new technologies and assistive automation, and workplace satisfaction** We seek to ensure that aviation vocations are supported with the proper skills, training, and working environments to deliver reliable and safe operations, and tasks are executed with professionalism and diligence. To do so, the OneAviation community would go beyond employer or enterprise-specific efforts, to sector or community-level cooperation through tripartite working groups and dialogues. Community action to support and develop airside professionals seek to also improve recruitment and retention rates. These efforts help to strengthen the existing workforce with new entrants to support growing operational demands. With sufficient manpower, we can reduce workload-related errors or procedural deviations.	2027	CAAS, CAG, Unions

D.	Action	Completion	Lead
3.	**Explore the use of new technologies to enhance pilot training and assessment** There is a need to look ahead into new technologies that can enhance flight crew training to improve safety. For instance, eye tracking is being explored by the industry to support pilot training by identifying scan patterns and rates that might help correct techniques for better outcomes. The expanded use of flight training device technologies within the training ecosystem may also help improve outcomes, especially for ab-initio pilots.	2027	CAAS, Industry
4.	**Launch initiatives to enhance understanding on Crew Resource Management (CRM) and Threat and Error Management (TEM) for general aviation pilots** CRM and TEM have been shown to be highly effective tools for improving aviation safety. Such training for commercial pilots is mandatory. General aviation pilots face many of the same risks but generally do not receive any tailored training. Greater safety promotion efforts for this community will be necessary.	2026	CAAS
5.	**Develop guidance on Competency-Based Training and Assessment (CBTA) and partner with stakeholders to ensure effective implementation of CBTA in the flight crew training regime** New CBTA regulations were promulgated in late 2024. Further guidance material will be needed to support Aviation Training Organisations (ATOs) and other industry stakeholders on the implementation of the new requirements. CAAS and ATOs will also need to work together to validate the proper implementation and effectiveness of CBTA flight crew training programmes.	2025	CAAS, Industry
6.	**Expanding CBTA implementation to other parts of the aviation ecosystem** The CBTA approach has revolutionised aviation training by emphasising practical skills, critical thinking, and real-world application over traditional rote learning. As the aviation sector evolves, CBTA will help enhance operational efficiency, improve safety standards, and build a more adaptable workforce. CAAS aims to support the industry in gaining a better understanding of CBTA, as well as facilitating the expansion of CBTA implementation to other parts of the ecosystem.	2027	CAAS, Industry, Unions

D.	Action	Completion	Lead
7.	**Develop recommendations for the effective leveraging of partnerships and resources beyond the aviation sector** In light of workforce constraints, CAAS and industry stakeholders should leverage independent resources to support the development of safety enhancement initiatives. For instance, partnerships with research agencies can enable research and insights into complex safety issues, the development of solutions, and evaluations of existing safety initiatives.	2026	CAAS, Industry, Research agencies
8.	**Continue to support the implementation of the various ASEAN aviation safety-related initiatives under the Kuala Lumpur Transport Strategic Plan (KLTSP) and its succeeding Plan** There are a number of aviation safety-related initiatives under the ASEAN KLTSP that will be renewed in 2025. These ongoing initiatives include the AFOSA, Mutual Recognition Arrangement – Flight Crew Licensing (MRA-FCL), and MRA – Maintenance Organisations (MRA-145), which facilitate collaboration and harmonisation of aviation safety oversight and regulation efforts among ASEAN Member States.	2027	CAAS

Related SSP Safety Objective(s):	• Ensure that hazards in Singapore's aviation operating environment are proactively identified, and related risks assessed and mitigated to as low as reasonably practicable. • Foster a positive safety culture and strengthen cooperation among industry stakeholders. • Pursue and advocate for the enhancement of aviation safety regionally and globally.
Related GASP Goal(s):	• Goal 1: *Achieve a Continuous Reduction of Operational Safety Risks* • Goal 3: *Establish and Manage State Safety Programmes* • Goal 4: *Strengthen Collaboration at the Regional and National Levels to Address Safety Issues*



APPENDIX –
ABBREVIATIONS AND ACRONYMS

AAM	Advanced Air Mobility
ADREP	Accident/Incident Data Reporting
AFOSA	ASEAN Foreign Operator Safety Assessment
AI	Artificial Intelligence
ANSP	Air Navigation Services Provider
AOC	Air Operator Certificate
AP-RASP	Asia-Pacific Regional Aviation Safety Plan
AP-SAS	Asia-Pacific Summit for Aviation Safety
ASEAN	Association of Southeast Asian Nations
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATO	Aviation Training Organisation
AV	Autonomous Vehicle
CAAS	Civil Aviation Authority of Singapore
CAG	Changi Airport Group
CBTA	Competency-Based Training and Assessment
CFIT	Controlled Flight Into Terrain
CGH	Changi General Hospital
CRM	Crew Resource Management
CST	Collaborative Safety Team
CVR	Cockpit Voice Recorder
eVTOL	Electric Vertical Take-Off and Landing
FCL	Flight Crew Licensing
FIR	Flight Information Region
GASP	Global Aviation Safety Plan
G-HRCs	Global High-Risk Categories
GNSS RFI	Global Navigation Satellite System Radio Frequency Interference
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IRM	Integrated Risk Management
KLTSP	Kuala Lumpur Transport Strategic Plan
LOC-I	Loss of Control In-flight
MAC	Mid Air Collision
MRA	Mutual Recognition Arrangement
MRO	Maintenance, Repair and Overhaul
MSS	Meteorological Service Singapore
NASP	National Aviation Safety Plan
NASP-WG	National Aviation Safety Plan Working Group
PBN	Performance Based Navigation
RE	Runway Excursion
RI	Runway Incursion
RSAF	Republic of Singapore Air Force
SAA	Singapore Aviation Academy
SDCPS	Safety Data Collection and Processing System
SMS	Safety Management Systems
SPIs	Safety Performance Indicators
SSP	State Safety Programme
TEM	Threat and Error Management
TCAS	Traffic Collision Avoidance System
TCAS-RA	Traffic Collision Avoidance System Resolution Advisory
TSI	Transport Safety Investigations
TSIB	Transport Safety Investigation Bureau
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
UTMS	Unmanned Traffic Management System