8. Air Traffic Management/ Air Navigation Services - ATM/ANS

The ATM/ANS Safety Risk Portfolio was first developed in 2017 by the Agency, in conjunction with the ATM/ANS Collaborative Analysis Group and has since been reviewed annually. Each safety issue contributes to one or more key risk areas as defined in the Introduction of this Volume.

Regarding the main key risk areas for this domain, refer to the EASA ASR 2021 Chapter 7 ATM /ANS Figure 132 'Key risk areas by aggregated ERCS score and number of risk-scored ATM/ANS occurrences'. These key risk areas are defined by their potential accident outcome and by the immediate precursors of that accident outcome. This figure is obtained by aggregating the ERCS score for the risk-scored occurrences relevant to this domain and plotting it against the number of risk-scored occurrences. The risk picture of this domain identifies the key risk areas of greater concern that are airborne collision, runway excursion, and aircraft upset.

The safety issues in the portfolio are sorted into the 'Assess – Elevated priority index', 'Assess – Normal-to-low priority index', 'Mitigate – define', 'Mitigate – implement', and 'Monitor' categories, which provide a snapshot of their status within the European SRM process by the priority. The safety issue prioritisation method is described in the Introduction of this Volume. To understand each safety issue better, please click on the safety issue in the list to access their description.

List 8-1: ATM/ANS safety issues per category & priority

Assess - Elevated priority index

Facilitates Step 2: Assessment of safety issue

- Undetected occupied runway (SI-2006)
- Mass diversions (SI-2032) (Amended) (CC effect)
- Airspace infringement (SI-2025)
- Airborne collision with an unmanned aircraft system (UAS) (SI-2014)

Assess - Normal-to-low priority index

Facilitates Step 2: Assessment of safety issue

- Level bust (SI-2004)
- High energy runway conflict (SI-2005)
- Deconfliction with aircraft operating with a malfunctioning or non-operative transponder (SI-2002)
- Inefficient conflict detection with the closest aircraft (SI-2003) (Amended)
- Landing/take-off/crossing without clearance (SI-2007)
- Safety issues raising from new technologies and automation (e.g. remote tower, SWIM) (SI-2015)
- Cybersecurity (SI-2013)
- Use of more than one language on frequency (SI-2029) (NEW)
- Failure of air-ground communication service (SI-2018) (Amended) (CC effect)
- Inaccurate provision of weather information (wind at low height) (SI-2009) (Amended)
- Inaccurate provision of weather information (turbulence/windshear/convective weather) (SI-2008) (Amended)

- Failure of surveillance service (SI-2017) (Amended) (CC effect)
- Failure of navigation service (SI-2016) (Amended) (CC effect)
- Airborne sector overload (SI-2019) (Amended) (CC effect)
- Lack of understanding and monitoring system performance interdependencies (SI-2022) (Amended)

Mitigate - define

Facilitates Step 3: Definition and programming of safety actions

- ACAS RA not followed (SI-2001)

Mitigate - implement

Facilitates Step 4: Implementation and follow-up of safety actions

- Airborne separation (SI-4010)
- Lack of effectiveness of safety management system (SI-2026) (Amended)

Monitor

Facilitates Step 5: Safety performance measurement

- ATCO-pilot operational communication (SI-2027)
- Inadequate procedure design and obstacle publication (SI-2028) (Amended)

ACAS RA not followed (SI-2001)

The anti-collision avoidance system (ACAS) is considered one of the last lines of defence in preventing an airborne collision. This safety issue pertains to the situations where the flight crew of one or both aircraft ignore the ACAS RA, react excessively late, do not follow the instruction regarding vertical rate precisely or respond in opposite direction. Flight crew are required to comply immediately with all resolution advisories (RAs), unless doing so would endanger the aircraft. Similarly, air traffic controllers (ATCOs) are required not to provide further air traffic control (ATC) instructions once the flight crew reports the RA. The appropriate responses which flight crew and ATCOs are expected to demonstrate in the event of an ACAS RA are outlined in ICAO and EU regulatory documentation.

Airborne collision with an unmanned aircraft system (UAS) (SI-2014)

The increasing popularity of drones, especially drones of less than 25 kg operating in the 'open' category, has inadvertently led to an increase of airborne collision risk between drones and manned aircraft. This is largely due to unauthorised activity of drones in both take-off and approach paths of commercial airlines up to 5 000 ft. While less common, unauthorised activity of drones may also pose a collision hazard when an aircraft is flying en-route. Authorised UAS operations in the 'specific' category may include UAS flights at altitudes at which other (manned) aircraft will fly, and therefore these could possibly pose risks as well. For example, failure of the UAS guidance and control system or degradation of technical systems supporting e-identification, geo-fencing, detect and avoid, (self)-separation or collision avoidance, could increase the risk of airborne collision with a UAS. Also, human factors (HF) issues and unintended remote pilot/operator errors could result in airspace violations, procedural deviations, and altitude deviations (thereby increasing the risk of airborne collision).

This safety issue is exacerbated by the fact that UAS are often not detected by ground equipment and/or on-board conspicuity devices of other aircraft.

As a result of a drone sighting, aerodrome traffic may be stopped or diverted, leading to secondary risks, such as fuel shortages, airspace capacity saturation and an increased workload of air traffic controllers and pilots.

Airborne sector overload (SI-2019) (Amended) (CC effect)

Sector overload refers to a complex situation where the ATCO on operational duty can no longer manage the existing levels of air traffic in a safe manner. As ATCOs are personnel responsible for the safe, orderly and expeditious flow of air traffic, it is important to address any situation which impairs the controller's ability to achieve the desired levels of safety. A complex situation may arise due to a confluence of external or internal factors. External factors include aircraft deviation from the planned trajectory, unexpected bad weather conditions, reduction of available airspace, amongst others. Internal factors include degradation of ATM system performance, parallel system maintenances, blocked runway, amongst others. When assessed individually, some of these contributory factors may have a minor impact on safety. However, when compounded, these factors may manifest in unsafe management of the traffic demand.

Airspace infringement (SI-2025)

Airspace infringement occurs when an aircraft enters notified airspace without previously requesting and obtaining clearance from the controlling authority of that airspace or enters the airspace under conditions that were not contained in the clearance. Such infringements pose a safety risk to traffic within the controlled airspace and increase the air traffic controllers' workload. The safety issue addresses infringements by aircraft flying using VFR in controlled airspace (Class A to D), aircraft accessing airspace without ATC clearance, and infringements of restricted airspaces such as danger areas, restricted areas, prohibited areas and temporary segregated/reserved areas by all types of traffic.

Inadequate ATCO-pilot operational communication (SI-2027) (Amended)

Good communication between air traffic controllers (ATCOs) and flight crew is essential in ensuring clear understanding of instructions and maintaining situational awareness. ATCO-pilot communication deficiencies may lead to all types of serious incidents and accidents. Common issues include three or more instructions in a single clearance, incorrect use of standard phraseology, misuse of the aircraft emergency frequency (121.5 MHz), and the uncoordinated introduction of phraseology.

Inefficient conflict detection with the closest aircraft (SI-2003) (Amended)

Air traffic controllers (ATCOs) may not detect a conflict between one aircraft and another aircraft close to it due to attention failure. Attention is a limited resource and numerous processes compete for it. In blind spot events the needed elements of attention — vigilance (maintaining awareness) and focus (concentration on the task) — are adversely affected by:

(1) competition for the attention resources from other tasks, attempts to remember, increased mental workload; and

(2) erosion of the attention resources by filtering mechanisms and physiological factors like distraction and fatigue.

ATCOs usually experience this loss of separation 'blind spot' after an incorrect descent or climb clearance in the context of a rapidly developing situation. There is normally very little or no time to react and most of the conflicting clearances result in an incident. The scope of this safety issue is limited to controlled airspace. While airspace infringements may potentially result in a controller blind spot, these events are excluded from this safety issue as they are addressed in the 'Airspace Infringement (SI-2025)' safety issue.

Cybersecurity (SI-2013)

ATM systems have become increasingly digitalised to reap efficiency gains. However, a move towards the digital sphere exposes ATM systems to more vulnerabilities and threats to confidentiality, integrity and availability of

the systems. Given the strong interdependence of the different domains in the aviation industry, a cyberattack on ATM systems may compromise safety and integrity of the aviation system as a whole. In addition to terrorist-related attacks, the safety issue is concerned with how ATM systems can remain resilient in the face of attacks perpetrated by hackers to gain access to systems or cause disruption for non-terrorist purposes and attacks carried out for commercial espionage. Link with SI-5017 'Cyber attacks'.

Airborne separation (SI-4010)

Ineffective deconfliction of flights adhering to instrument flight rules (IFR) and visual flight rules (VFR) in an airspace class where at least one of the flights is not under air traffic control (ATC) separation has been identified as a strong contributor to airborne collision risk. Such airspace classes include class E, controlled airspace where VFR flights are not subject to ATC clearance and no IFR-VFR separation is provided by ATC, and class G, where neither IFR flights nor VFR flights are subject to ATC clearance and ATC does not provide any separation service. The safety issue arises due to the fragmented knowledge of the traffic situation as some traffic is subject to ATC clearance (i.e. IFR) and some traffic is not (i.e. VFR). ATC may not be aware of VFR flights or their intentions and potentially may not pass traffic information to the IFR traffic. In addition, some of the VFR traffic may not be equipped with airborne collision avoidance system (ACAS) or even a transponder (C or mode-S), reducing the conspicuity of VFR traffic. As a result, both IFR and VFR traffic have to rely solely on the visual acquisition by the flight crew to maintain separation. This safety issue addresses how the conspicuity of VFR traffic can be improved as well as best practices to underscore the importance of existing procedures in maintaining airborne separation. This safety issue is captured in the Non-Commercial Operations – Small Aeroplanes Safety Risk Portfolio and is also relevant to the Commercial Air Transport – Aeroplanes domain. Link with SI-4010 of the NCO SA portfolio and SI-0043/SI-4010 in the CAT A portfolio.

Deconfliction with aircraft operating with a malfunctioning/non-operative transponder (SI-2002)

When an aircraft with a non-operative transponder or malfunctioning transponder operates in an airspace where aircraft must be equipped with a secondary surveillance radar (SSR) transponder, the incorrect information transmitted by the transponder increases the risk of airborne collision or terrain collision. Without a functioning transponder, ATC may be misled by the incorrect data on the aircraft's position, and this may result in ATC issuing a clearance which poses a safety risk to another aircraft or to the aircraft itself if the clearance directs it into a terrain e.g. a mountain. As the operation of ACAS is contingent on a functioning transponder, other nearby aircraft will not be able to receive traffic advisories or RAs to maintain separation with the aircraft without a functioning transponder should the need arise. This safety issue explores the frequency of such occurrences and whether the existing procedures suffice in mitigating the risk posed by aircraft operating without a functioning transponder.

Failure of air-ground communication service (SI-2018) (Amended) (CC effect)

Failure of the air–ground communication system may degrade the performance of the communications service and increase safety risk to an unacceptable level. Air–ground communication refers to aeronautical fixed and mobile services to enable air-to-ground voice or data communication for air traffic control (ATC) purposes. Common failures in voice communications include radio equipment malfunction (in the air and on the ground), loss of communication, blocked frequency, radio interference, and sleeping VHF receiver problem. Another key mode of the air–ground communication service is controller–pilot data link communications (CPDLC), which allows air traffic controllers to transmit non-time-critical messages to an aircraft as an alternative to voice communications. Common failures in CPDLC include technical failure of the data link equipment (air and ground) and disconnections known as 'provider aborts'. This safety issue explores how such failures can be prevented using pre-emptive measures and the best practices to manage such failures on a tactical basis when they occur. The impact of the failure of air–ground communication service includes the entire provision of air traffic service (ATS).

Failure of navigation service (SI-2016) (Amended) (CC effect)

Failure of the navigation service can lead to the loss of the facilities and services (VOR, DME, ILS, GNSS, NDB) that support aircraft with positioning and time, and thus increase safety risk to an unacceptable level.

This could potentially lead to the situation that the crew does not know the correct position of the aircraft, or the indicated position is not correct. This could lead to the overload of the air traffic controllers when they are required to provide the missing information verbally or via the system. For example, a corrupted/interrupted ILS signal can lead to an unstabilised approach, go-around, and even CFIT.

This safety issue covers appropriate maintenance, procedures to identify failures and their impact on ATS, procedures to operate in degraded modes of operation, and training of staff to deal with abnormal situations.

Failure of surveillance service (SI-2017) (Amended) (CC effect)

Failure of the surveillance service may degrade the performance of ATS and increase safety risk to an unacceptable level. Surveillance systems are used by air traffic control to determine the respective positions of aircraft to allow safe separation. Such systems include PSR, SSR, GNSS and Automatic Dependent Surveillance – Broadcast (ADS-B), Wide Area Multilateration (WAM) and systems for processing and displaying surveillance data.

Effective management of these systems is essential in minimising the impact on ATS. This safety issue covers appropriate maintenance, procedures to identify failures and their impact on ATS, procedures to operate in degraded modes of operation, and training of staff to deal with abnormal situations.

High-energy runway conflict (SI-2005)

A high-energy runway conflict occurs when there is little or no time for the air traffic controllers to react to a potential conflict between a high-energy landing (indicated airspeed (IAS) of 100 knots or more) or take-off (IAS of 80 knots or more) and an aircraft which has infringed an active runway, which is also known as a runway incursion. Runway incursion is defined as any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft. Thus, this safety issue addresses a specific subset of runway incursions.

Inaccurate provision of weather information (turbulence/windshear/convective weather) (SI-2008) (Amended)

Inaccurate or missing weather information on weather phenomena such as turbulence, windshear, and convective weather on board the aircraft (flight crew) and on ground (ATCOs) may lead to aircraft flying through weather phenomena without warning. Depending on the severity of the weather phenomena, passengers or cabin crew may sustain injuries on board. This safety issue is focused on IFR flights in the en-route/approach environment, where improvement in the provision of meteorological information will enable controllers to better manage traffic flows and pass weather information to pilots.

Inaccurate provision of weather information (wind at low height) (SI-2009) (Amended)

The landing phase is considered one of the highest-risk phases of flight due to the high cockpit workload and execution of difficult tasks such as the landing flare. Weather information near the surface of the runway such as tail wind on ground and cross wind is crucial to assist flight crew during the landing phase. Inaccurate weather information may contribute to non-stabilised approaches and increase the risk of runway excursions. As this topic spans across several aviation domains, the scope of this safety issue is focused on the ANSPs' and ATC's role in ensuring that accurate and timely weather information is provided to flight crew during the landing phase.

Inadequate procedure design and obstacle publication (SI-2028) (Amended)

With the advent of new navigation systems, the design of instrument flight procedures (IFPs) and its publications have become key enablers of the ATM system globally. They must therefore be managed to ensure that quality-assured procedures are provided in support of ATM operations. Poorly designed IFPs can increase the risk of loss of separation, level bust and CFIT. In addition to well-designed IFPs, it is also essential to ensure that information relating to the IFP is accurate and updated in a timely manner. This reduces potential discrepancies during the take-off/approach of the flight.

Lack of effectiveness of safety management system (SI-2026)

Ineffective implementation of safety management systems may lead to deficient management of ATM/ANS risks within the service provider organisations. The complex nature of aviation safety and the significance of addressing HF aspects justify the need for an effective management of safety by the aviation organisations. Shared understanding between regulatory/competent authorities and air navigation service providers is imperative for an effective SMS functioning in an already ultra-safe industry, like aviation. However, the lack of competent and experienced inspectors and regulatory authorities lead to the risk of bureaucratising SMS seeing it only as a compliance system. This safety issue covers the regulatory requirements and promotion of SMS principles, on both aviation authorities and organisations, and the capability to detect and anticipate new emerging threats and associated challenges. This safety issue is mitigated through the SES Performance and Charging Scheme'.

Lack of understanding and monitoring system performance interdependencies (SI-2022) (Amended)

The safety performance of the ANSPs can be affected by a multitude of internal and external factors. While most ANSPs are adept at managing the safety hazards related to their provision of services, it is also important to consider the impact of external factors such as commercial pressure and demands related to increasing capacity and environmental protection on the safety performance of ANSPs. It is important to strike a balance between the competing priorities of safety, efficiency, capacity and environment protection, especially in view of limited resources in most ANSPs. To understand such trade-offs better, regulators and ANSPs should analyse safety performance using a dynamic safety model, such as Rasmussen's Migration Model, and develop guidelines to prevent ANSPs from drifting towards unsafe operations under the influence of competing priorities. Metrics related to factors that have not been traditionally linked to safety performance can be developed to monitor this practical drift and serve to provide 'weak signals' in ATM safety performance.

Landing/take-off/crossing without clearance (SI-2007)

Aircraft landing, taking-off and crossing runways without clearance from the air traffic controller (ATCO) poses a significant runway collision risk. Such events typically happen during critical and high-workload stages of the flight and can result in similar hazardous outcomes, such as runway incursion and runway collision. The safety issue covers contributory factors from both the flight crew and ATCOs ranging from call sign confusion, runway confusion, incorrect phraseology and expectation bias to cockpit overload.

Level bust (SI-2004) (Amended)

Level bust is defined as any unauthorised vertical deviation of more than 300 ft from an ATC flight clearance. Within reduced vertical separation minima (RVSM) airspace, this limit is reduced to 200 ft. Level bust contributes towards the airborne collision and CFIT key risk areas when the aircraft fails to fly at the level to which it has been cleared. Such events may occur due to communication error, flight crew error in entering the clearance in the flight control unit and insufficient time for the flight crew to react to a late re-clearance.

Mass diversions (SI-2032) (Amended) (CC effect)

Mass diversions due to airspace and/or airport closure have pervasive repercussions on various aviation domains, ranging from ATC to flight operations, due to their extensive nature. The large amount of displaced traffic results in an overload for ATC and increase workload for the flight crew. This carries the potential for loss of separation as well as other risks related to high-workload tasks and situational awareness. This safety issue covers policies regarding fuel emergencies, air traffic flow management, ensuring that alternate aerodromes have sufficient capacity, and diversions from many airports to one.

Safety issues raising from new technologies and automation (SI-2015) (Amended)

This safety issue refers to the potential increase in safety risks due to the complexities arising from the introduction of new technology and concepts in ATM such as remote tower operations and system wide information management (SWIM). With more complex automation, it is important to address the relationship between humans and automation within the framework of a contemporary safety management system.

Undetected occupied runway (SI-2006)

This safety issue pertains to runway incursions by an aircraft landing on or taking-off from an already occupied runway. This could be due to oversight by air traffic controllers, aerodrome design or other organisational factors. Especially during periods of high workload, the controller may accidentally clear an aircraft or a vehicle to enter a runway even though they had already cleared another aircraft to land on or take-off from the same runway. Aerodrome design is also another key contributor to this safety issue as flight crew or manoeuvring area vehicle drivers may navigate onto the wrong surface if the design of the aerodrome may lead to disorientation.

Use of more than one language on frequency (SI-2029) (New)

This safety issue refers to the risk that occurs when using different languages at the same time on the ATC frequency. Despite that the default language of international aviation worldwide is English, local languages are used concurrently for air–ground communication. Under certain circumstances, pilots might prefer to use their native language to address controllers and controllers might address ground personnel in their native language. Having several aircraft on one frequency, the result might be that certain aircrews do not understand clearances given to an aircraft in the same airspace and the responses of the aircrew. Therefore, the aircrew might not be aware of what the other aircrew is about to do. This can lead to the loss of situational awareness of the involved parties with regard to the respective other traffic in the same airspace.