NM Top 5 Safety Priorities

Safety Functions Map Analysis of 2024 European A and B severity safety incidents

Edition: 1.0
Edition date: 10-11-2025
Classification: Green
Reference nr:

Document Control

Document Title	NM Top 5 Safety Priorities
Document Subtitle	Safety Functions Map Analysis of 2024 European A and B severity safety incidents
Document Reference	
Edition Number	1.0
Edition Validity Date	10-11-2025
Classification	Green
Status	Released
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Edition History

Edition No.	Validity Date	Author(s)	Reason
0.1	15/07/2025	NMD/SAF	First draft following analysis
0.2	18/07/2025	NMD/SAF	Internal review
1.0	10/11/2025	NMD/SAF	SAFOPS, NST, NDOP consultation

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1 Document overview and conclusions

The main purpose of this report is to document the process and the results of the Safety Functions Maps analysis of European A and B severity incidents, which was performed in 2025 within the context of Network Manager Safety Prioritisation Process. The analysis is based on 2024 incident data sample built by the occurrence data provided by European ANSPs.

This analysis also provides information regarding to barrier resilience. In this SAFMAP analysis the resilience is addressed by identifying the barrier that stopped an incident from propagating further on the accident trajectory. This is particularly relevant to barriers presented at the top of the SAFMAP model because if an incident is prevented by one of these top barriers it would, most probably, be of severity A or B. Therefore, the information in the sample is representative of the top barrier resilience performance. Additionally, information is presented on how barriers failed to stop an event propagating further and causing a more severe safety effect. This is particularly relevant to the barriers presented at the bottom levels of the model.

The document structure is as follows:

- Section 2 describes the analysed incident sample.
- Section 3 outlines the used analytical process.
- Section 4 provides a summary of the SAFMAP analysis of the incidents involving en-route separation minima infringement.
- Section 5 provides a summary of the SAFMAP analysis of the TMA/CTR incidents involving separation minima infringement.
- Section 6 provides a summary of the SAFMAP analysis of the runway incursion incidents.

Based on the conclusions of the incident data analysis, the following topics are suggested to be retained as safety priorities:

- “Controller Blind Spot”.
- “Restricted airspace infringement”.
- “Flight without a transponder or with a dysfunctional one”.
- “Controlled airspace infringement”.
- “Controller detection of potential runway conflict”.

Additionally, based on the conclusions of the incident data analysis, it is suggested to monitor the risk associated with:

- “High workload”.
- “Altitude deviation”.
- “Synchronisation of successive arriving to land and of arriving to land and departing aircraft”.
- “Non-commercial (VFR) flights at airports and in CTR/TMA”.
- “Incorrect presence of vehicles on the runway protected area”.

2 Incident Sample

2.1 Geographical representativeness of the sample

The SAFMAP review sample is judged to be representative for the purpose of identifying Top 5 priorities for the Network Manager based on its geographical representativeness. The SAFMAP review of incidents involved **33 Air Navigation Service Providers** (see Figure 2-1).

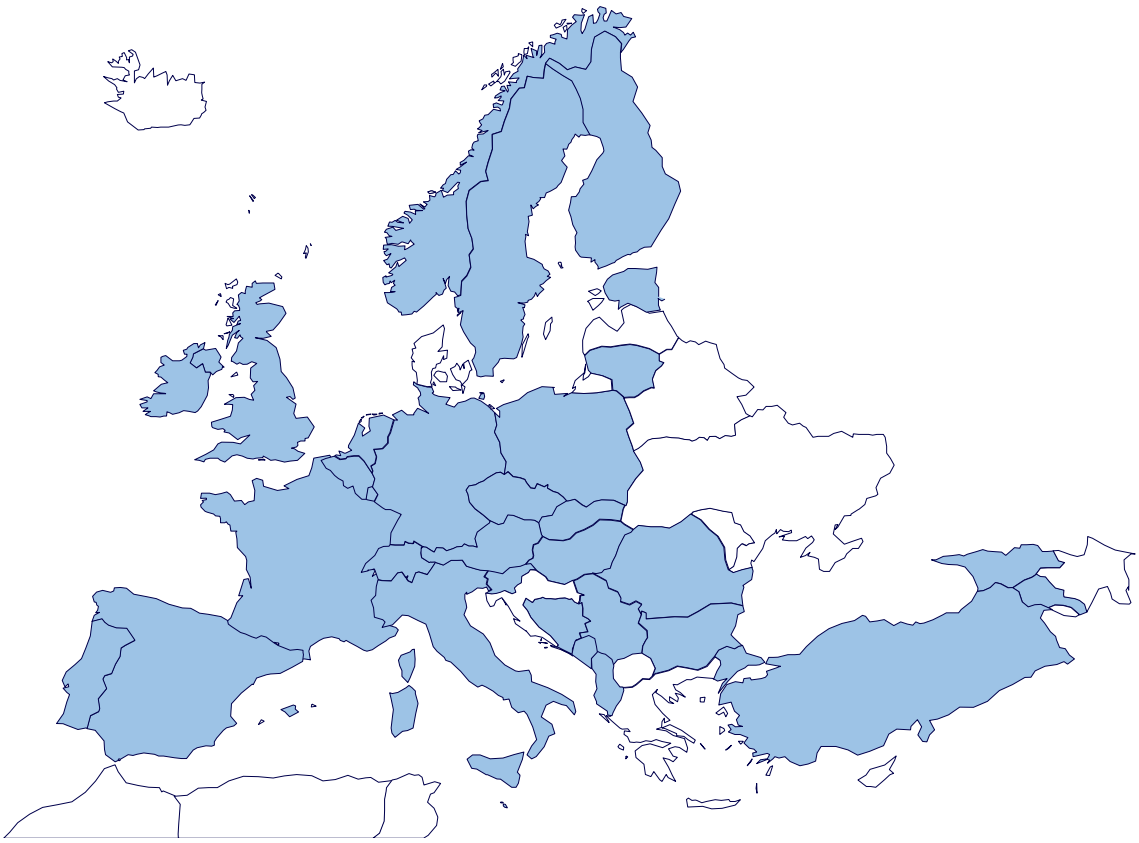

Figure 2-1: Participating ANSPs

2.2 Sample description

The analysed sample covers the three types of safety risk occurrences selected by EUROCONTROL Operational safety group (SAFOPS) and Safety Team:

- Separation minima infringement en-route,
- Separation minima infringement in TMA/CTR airspace,
- Runway incursion.

Other risks with ATC influence on the risk, such as CFIT, collision on the ground etc. are not part of the prioritisation process for the moment.

In total, 291 incidents of severity A or B, collected during the sessions with ANSP representatives, were analysed. In particular, the data sample illustrated in Figure 2-2 includes:

- 97 separation minima infringements in the en-route phase of flight, 7 of which have been classified as severity A and 90 as severity B or not classified (but considered to be of high-criticality) incidents – see the on-line dashboard here.
- 147 TMA/CTR related separation minima infringements, 9 of which have been classified as severity A and 138 as severity B incidents – see the on-line dashboard here.
- 47 runway incursions, 15 of which have been classified as severity A and 32 as severity B incidents – see the on-line dashboard here.

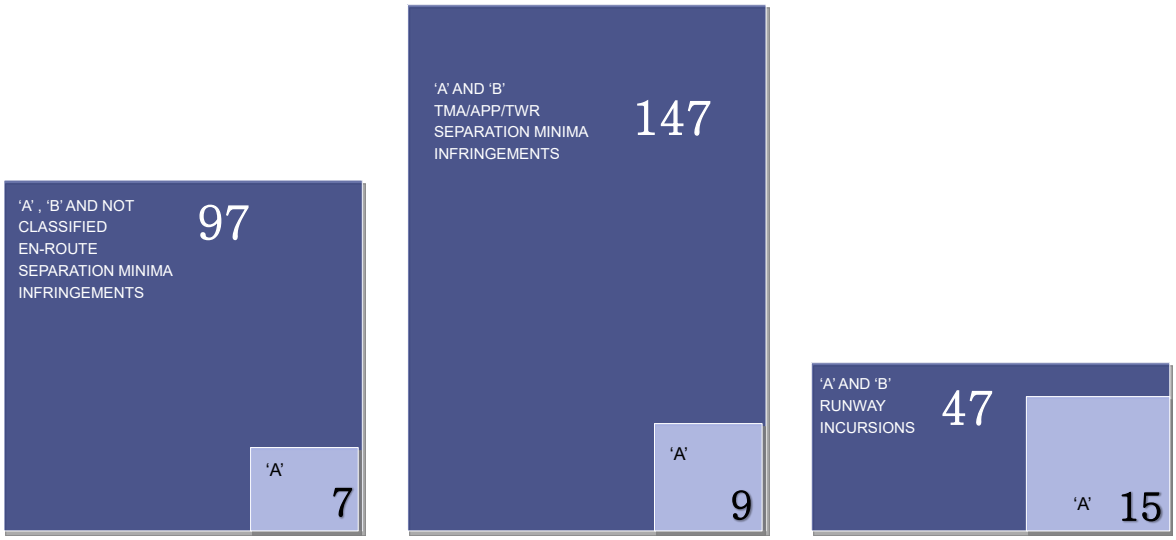

Figure 2-2: Analysed data sample

3 The Safety Functions Maps Analysis Process

3.1 Introduction to Safety Functions Maps

The SAFMAPs are barrier models based on a structured documentation of the available defences against particular unwanted accident outcomes. These barriers are either part of the ATM system (ground and/or airborne component) or can impact the safety performance of ATM and/or aircraft navigation.

Each discrete barrier is considered as a safety function. The functions used are rather generic, for example the function “Pilot/driver detection of potential RWY conflict and prevention of incorrect entry onto the RWY protected area” does not specify the actual means to implement this function such as stop-bars, runway guard lights or runway entry lights.

Similarly, “Prevention of overlooking potentially conflicting aircraft when issuing clearance or instruction” does not specify the actual means to implement this function such as MTCD, ATCO structured scan of their situation display, team member support, short-term conflict probe or Cleared Flight Level (CFL) processing and alerting by the STCA. Some functions are provided by procedures, some by technical systems and some by a combination of both.

A principle applied to the construction of SAFMAPs was to include all barriers which are available and ‘used by someone’ in the industry. This means that SAFMAPs serve also as a repository of best practices that are not necessarily required by regulations. Examples of these are the use of short-term conflict probes, A-SMGCS alerting functions or runway status lights.

SAFMAPs are hierarchical structures in which each higher-level structure (function) can be decomposed into several lower-level structures (functions). The highest levels are called basic safety functions. Each of these basic functions is then decomposed into more detailed Level 1 safety functions and, in the same manner, each of these Level 1 safety functions may be further decomposed into several Level 2 safety functions. At present, Level 4 is the most detailed specification and not all safety function levels are necessarily decomposed to the same extent. A function is decomposed further, only if there is a need demonstrated by the occurrence of several incidents that have illustrated different ways in which a particular function can be implemented and/or challenged.

The following examples are provided to illustrate this structure using the Mid-air collision SAFMAP. It has 6 basic safety functions and hereafter is illustrated the decomposition of one of these functions, notably “ATC Tactical Separation Assurance”:

- “Conflict-free ATC clearances and instructions” is an example of a Level 1 safety function.
- “Prevention of overlooking potentially conflicting aircraft when issuing clearance or instruction” is an example of a Level 2 Safety Function.

Starting with each basic safety function, the progressive decomposition of each safety function level into a more detailed lower-level functions results in the 'mapping' of how the safety function components at each lower level collectively provide the redundancy which delivers the higher-level safety function.

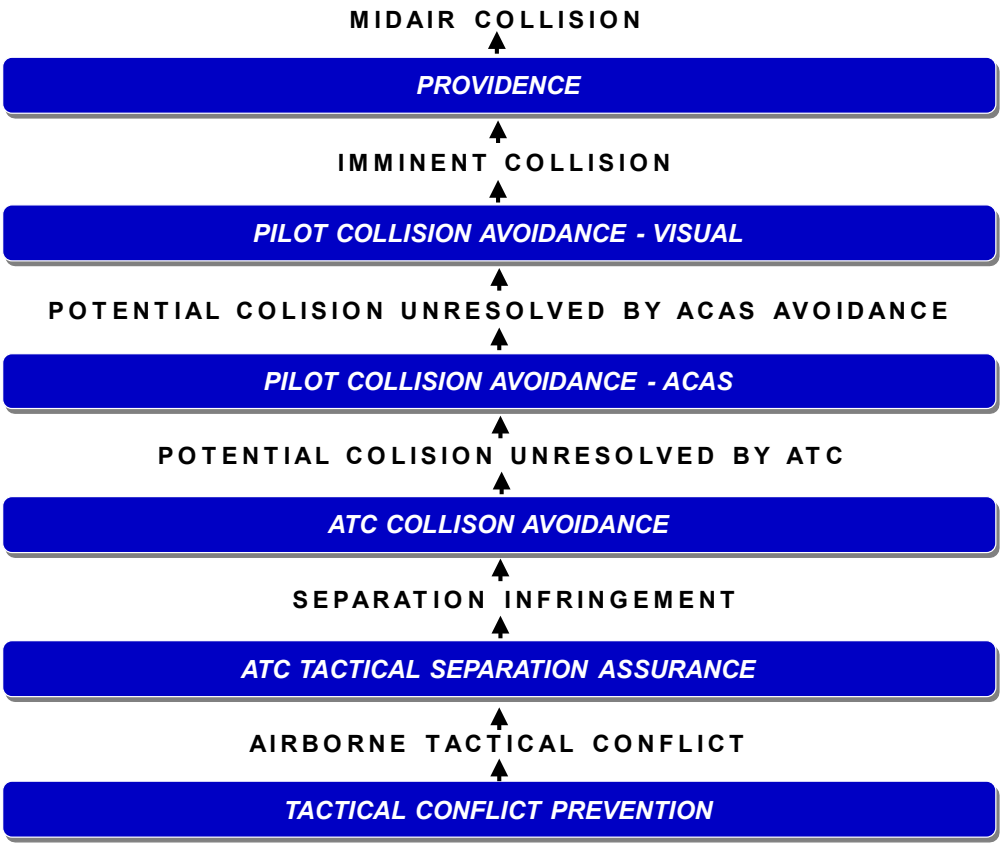

Figure 3-1: SAFMAP basic safety functions

When an incident is reviewed with the help of a SAFMAP, the objective is to identify all relevant safety functions. The process is not limited only to identifying the functions that failed (to stop the event producing effect of higher severity), but also those functions that worked and provided resilience. The following qualifications for a function are possible:

- Not challenged but available.
- Challenged and failed.
- Challenged and worked.
- Not challenged but not available.
- Not applicable to the scenario.

In this way, each incident is described in terms of qualified sequence of safety functions – failed, worked, not challenged or not applicable. This creates a very elaborate description of what happened in the particular scenario, i.e. what was observable. This can be called descriptive factor analysis for the description does not go into elaboration of why things happened, or in other words, what the explanatory factors are.

It is to be noted that very often there is not sufficient information available in the investigation report or provided during the data collection workshop discussions to systematically qualify the performance of all safety functions. Therefore, the information for some of them is either missing or a function is qualified without any contextual information.

3.2 How to read the barrier model?

Figure 3-2 illustrates an example of the graphics used to analyse and present incident data; in this case, it is the barrier model for runway collision.

The background arrow depicts the direction in which the incidents develop. Each incident is depicted as a circle before the barrier, which stopped its further propagation. All the barriers underneath the incident were already “crossed” by the developing event – meaning that the barriers failed. The fill colour, also shown in the Legend of the figures, illustrates how the conflicting trajectories were created - how the first barrier failed.

The big grey numbers on the left-hand side are an indicator of the overall number of incidents prevented by a given basic barrier.

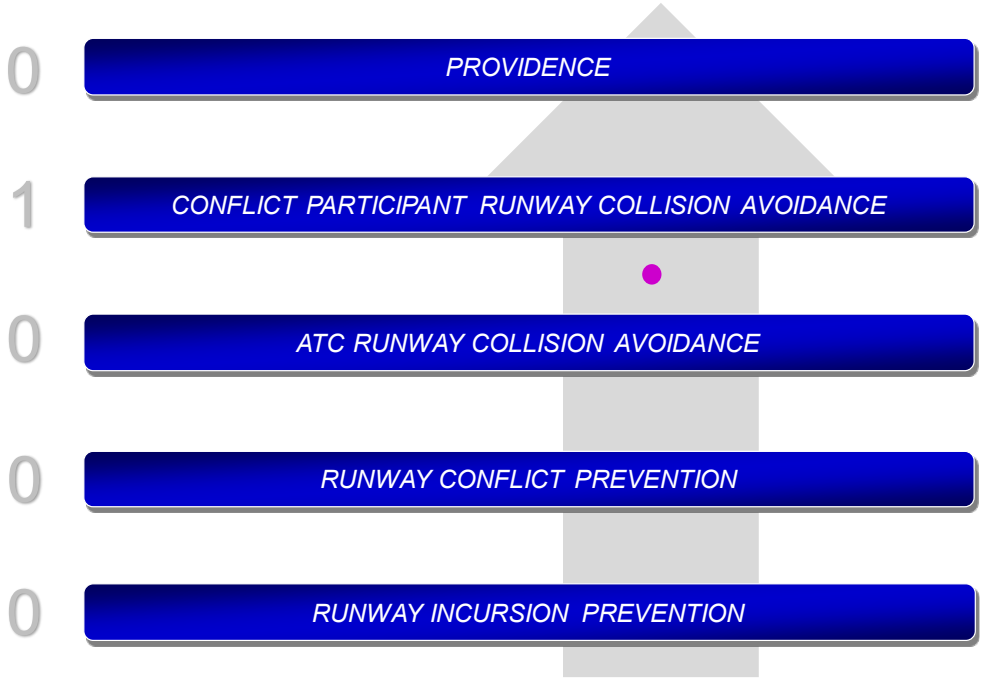

Figure 3-2: Incident data presentation example

In some figures there is information about incidents that were stopped between two barriers but not by the barrier itself. This is depicted by a technical thinner “barrier” than the “real barrier” and the text “No need”.

4 En-Route Separation Minima Infringements – Summary Analysis

4.1 Overall barrier performance – en-route

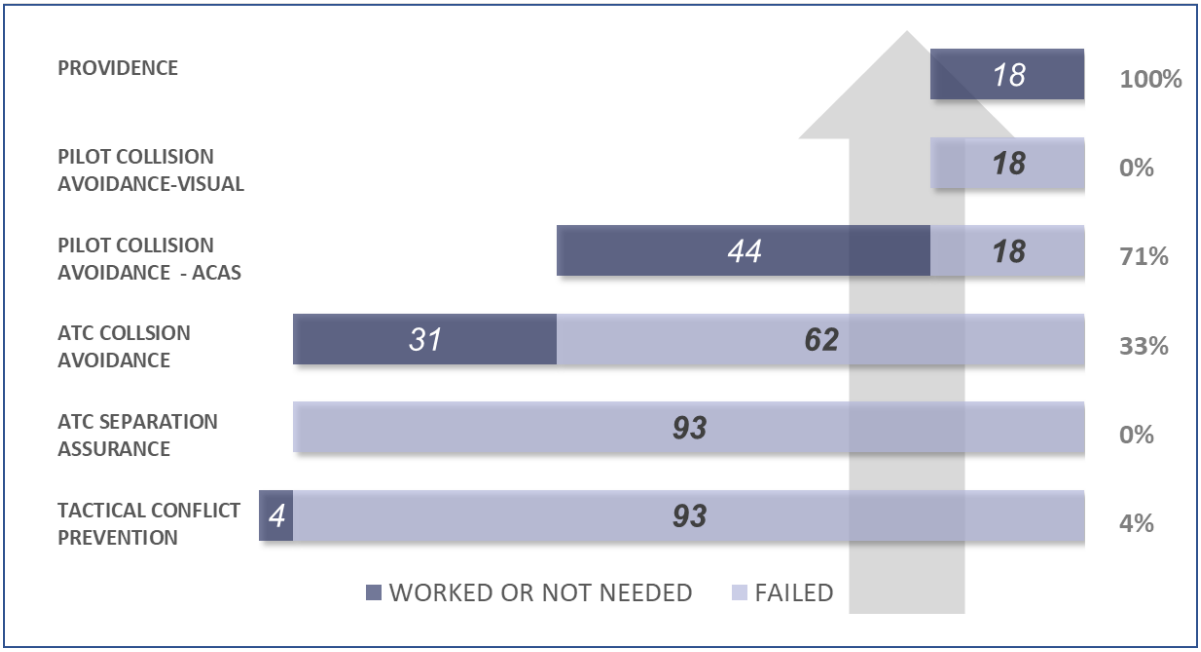

Figure 4-1: Overall barrier performance

- Performance of the Basic Barrier "Tactical conflict prevention": challenged 97 times, failed in 93 cases. This is not a surprise, due to the high severity (A and B) of the events included in the analysed data sample. In order to obtain a more reliable information about the barrier strength, incidents of lower severity (e.g. C, D and E) should be analysed, too.
- Performance of the basic barrier "ATC separation assurance": challenged 93 times, failed in 93 cases.
- Performance of the basic barrier "ATC collision avoidance": challenged 93 times, failed in 62 cases (67%) and worked or was not needed in 31 cases (33% success). In 11 cases this barrier was not needed.
- Performance of the basic barrier "Pilot collision avoidance - ACAS": challenged 62 times, failed in 18 cases (29%) and worked or was not needed in 44 cases (71% success). In 13 cases this barrier was not needed.
- Performance of the basic barrier "Visual collision avoidance": challenged 18 times, failed in 18 cases (100%). In 17 of the incidents where this basic barrier failed the initiator was restricted airspace infringement. The 18th one was caused by pre-tactical deconfliction procedures failure and involved a flight without functional transponder.
- Performance of the basic barrier "Providence": challenged 18 times, worked or was not needed in all cases (100% success).

4.2 Performance of first barrier "Tactical Conflict Prevention"

The figure below shows the distribution of the failure scenarios for the first barrier.

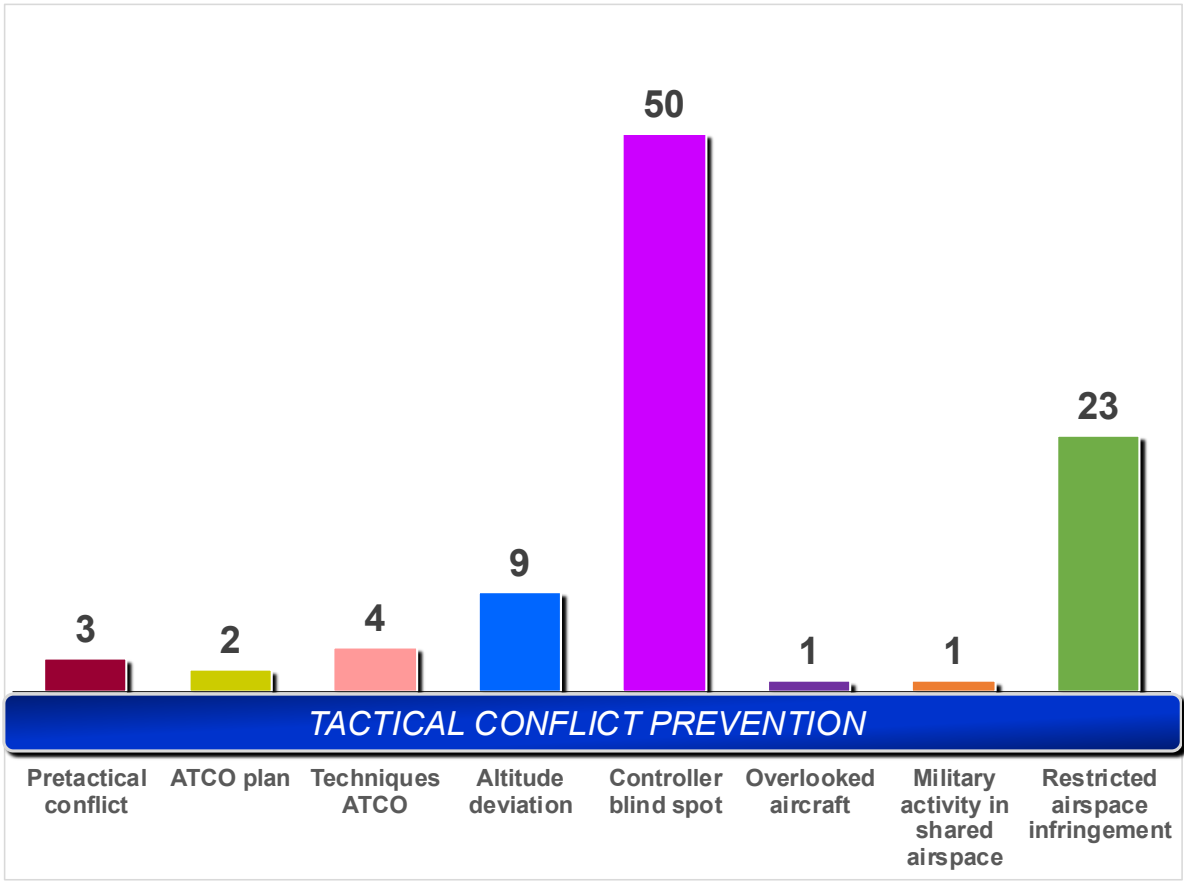

Figure 4-2: Incident data presentation example

Performance of the basic barrier "Tactical Conflict Prevention" – failed in 93 of 97 analysed events:

- In 50 incidents (54% of the failures) the conflict was generated by "Blind spot" – ATCO overlooking a potentially conflicting proximate aircraft when clearing or instructing another one.
- In 23 incidents (25% of the failures) the conflict was generated by "Restricted airspace infringement".
- In 9 incidents (10% of the failures) the conflict was generated by "Altitude deviation".
- In 4 incidents (4% of the failures) the pre-tactical conflict was not prevented by the "Inadequate ATCO controlling technique" function.
- In 3 incidents (3% of the failures) the conflict was generated by "ATC tactical planning".
- In 2 incidents (2% of the data sample) the conflict was generated by "Incorrect ATCO plan".
- In 1 incident (1% of the data sample) the conflict was generated by "ATCO overlooking an aircraft".
- In 1 incident (1% of the data sample) the conflict was generated by "Military flights in shared airspace".

The 4 events where this barrier worked were generated by “Restricted airspace infringement”.

It is worth noting that:

- Overlooking a conflicting aircraft (“Blind spot” and “ATCO overlooking an aircraft”) accounts for more than half (55%) of the events included in the 2024 en-route incident sample.
- The occurrences in the en-route sample are concentrated in two groups (“overlooking a conflicting aircraft” and “restricted airspace infringement”), accounting for almost 80% of all events.

4.3 Barriers' resilience per initiator

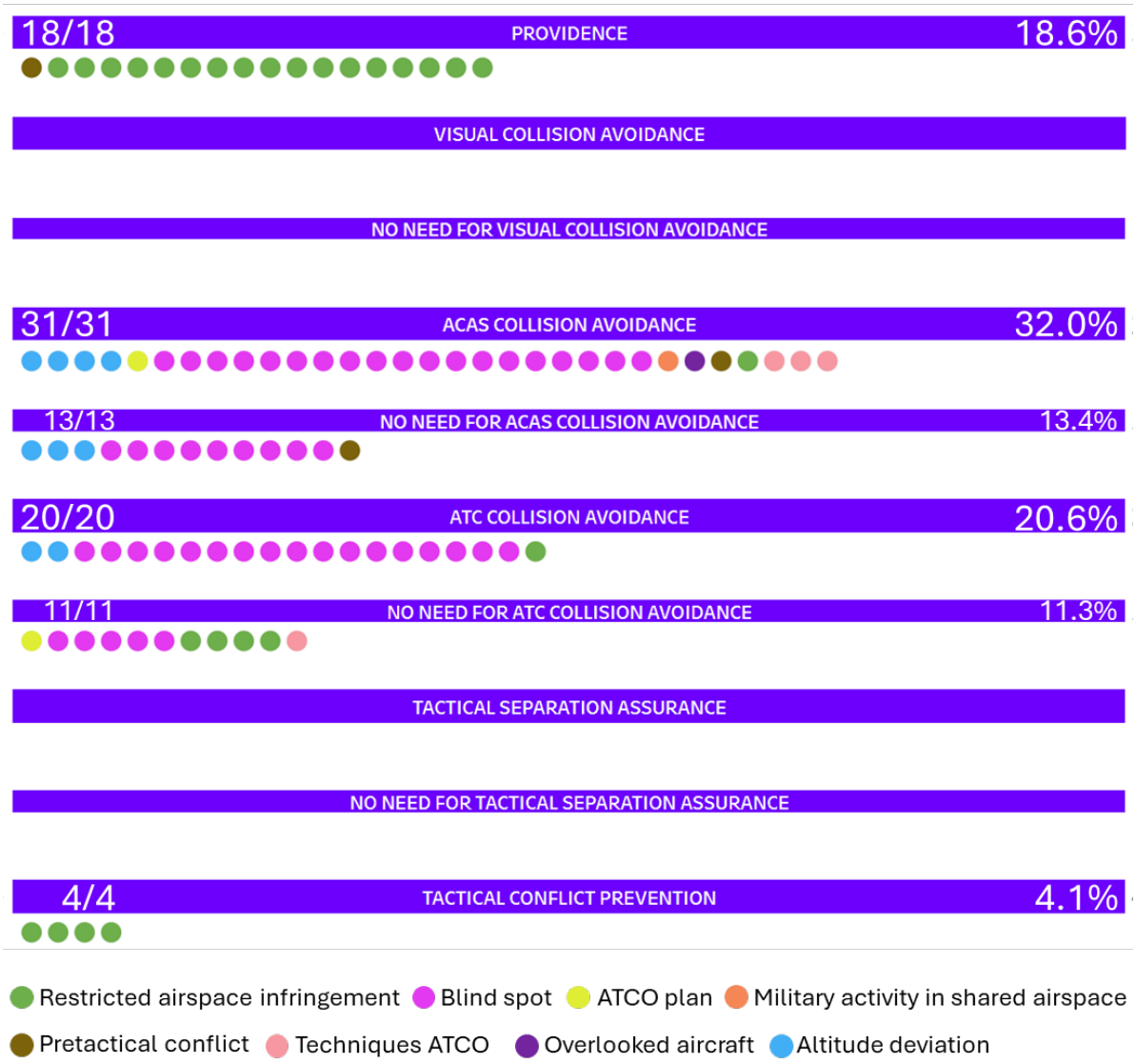

Figure 4-3: Barriers' resilience to initiators

Figure 4-3 illustrates the resilience of the barriers to the different initiators. The following can be noted:

- "Blind spot" represents about half of the incidents in the sample (50 out of 97). 38% (19 events) of these incidents were stopped by the "Pilot collision avoidance – ACAS" barrier, 34% (17 events) – by the "ATC collision avoidance" barrier and in 18% (9 events) the "ATC collision avoidance" barrier was penetrated but there was no need for ACAS collision avoidance.
- "Restricted airspace infringement" represents almost 30% of the incidents in the sample (27 out of 97). It also accounted for 17 out of 18 events that were stopped by the "Providence" barrier, the rest being stopped at the ATC Collison Avoidance barrier.
- "Altitude deviation" accounted for 10% of the incidents in the sample (10 out of 97). Most of these (7 out of 9) penetrated the "ATC collision avoidance" barrier and 4 of them were stopped by the "Pilot collision avoidance – ACAS" barrier.

4.4 "Blind Spot" events

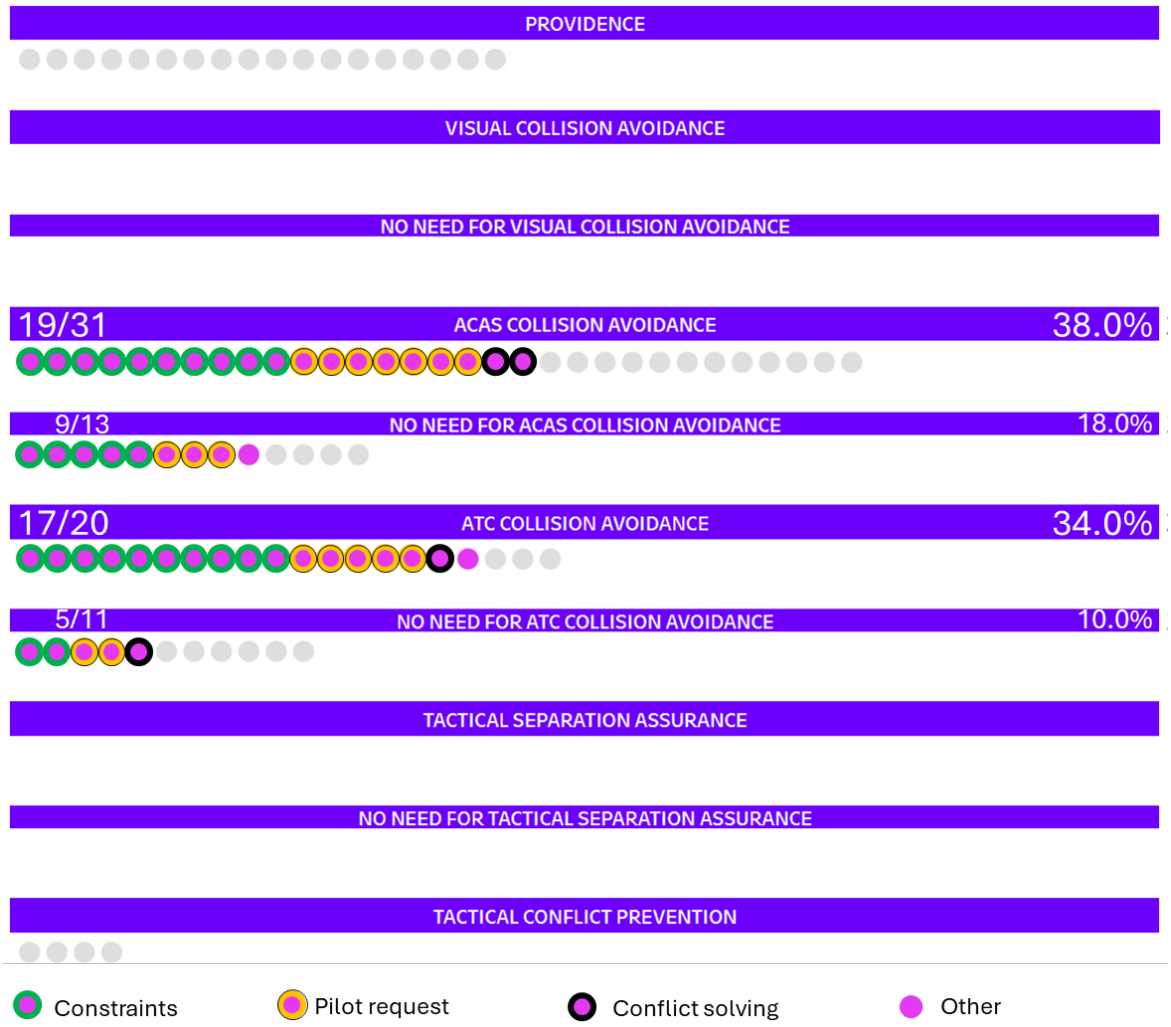

Figure 4-4: Blind spot events

Figure 4-4 provides insight into the specific initiators of the blind spot incidents. The following was identified:

- More than half of the occurrences (28 out of 50) were stopped at the ACAS barrier (i.e. all controller-reliant barriers have been breached). This was the most frequent scenario.
- More than half of the occurrences (27 out of 50) were caused by issuing an instruction in order to meet standing sector exit constraint or filed FL in the FPL route.
- In about a third of the events (17 out of 50) the conflicting clearance was issued after a pilot request to climb or descend.
- In four incidents the conflicting clearance was issued in order to solve another conflict.

Considering the criticality of the incidents and the fact that "Blind spot" is consistently the most frequent initiator during the last years, it is suggested to retain as a safety priority "Controller Blind Spot".

4.5 Restricted airspace infringement events

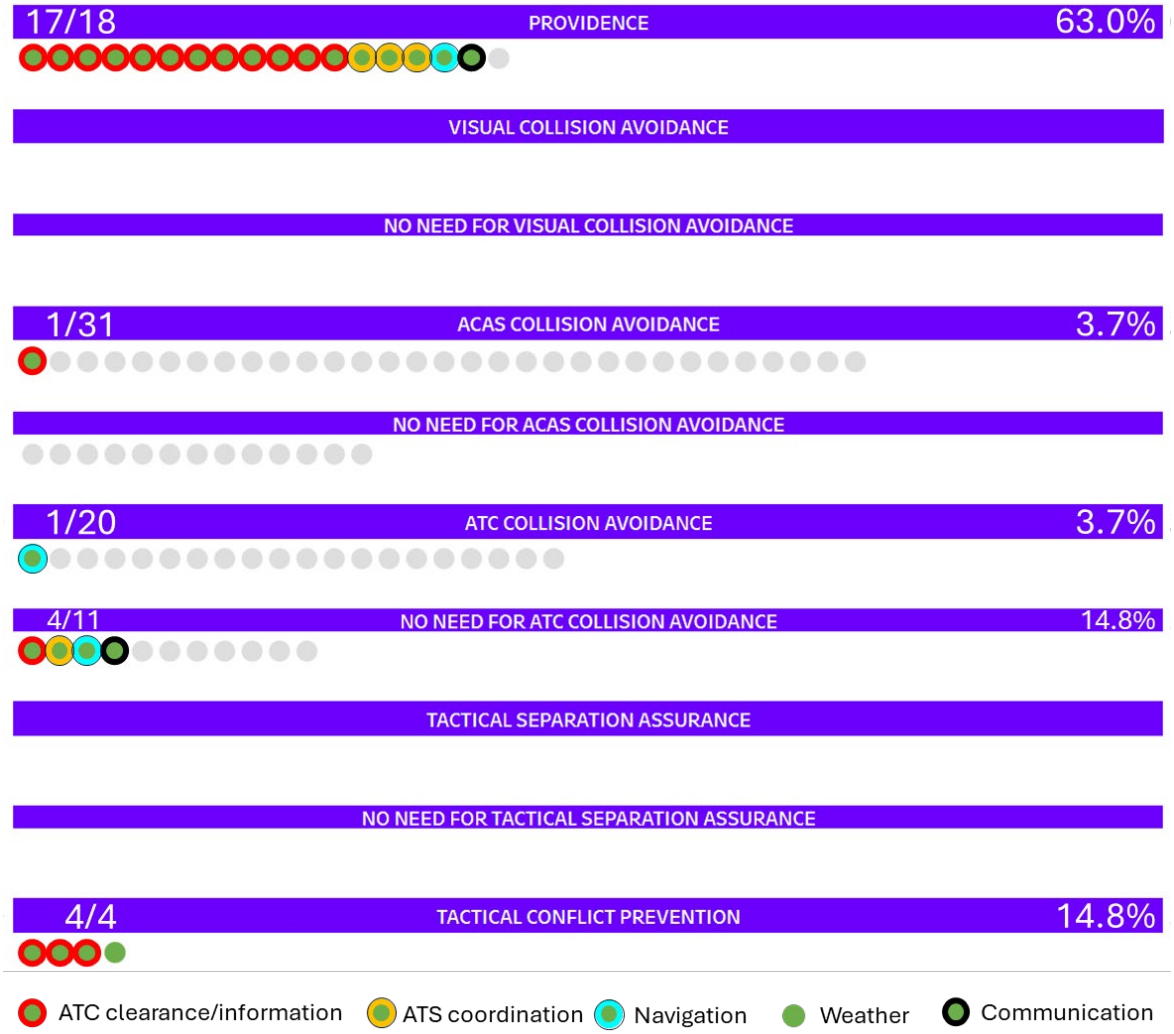

Figure 4-5: Restricted airspace infringement events

Figure 4-5 provides insight into the specific initiators of the restricted airspace infringement incidents. The following was identified:

- Restricted airspace infringement was the second most common initiator in the 2024 en-route sample.
- The restricted airspace infringement incidents are the events of highest safety criticality in the analysed 2024 en-route incident data sample. Almost 2/3 of those (17 out of 27) were stopped at the final barrier, “Providence”.
- Almost 2/3 of those (17 out of 27) were caused by inadequate ATC clearance or information passed to the flight crew. Of those, 12 (about two thirds) were only stopped at “Providence”.
- Inadequate ATS coordination was cited as initiator in 4 events, 3 of which were only stopped at “Providence”.
- Three events were caused by navigation errors. Two events were caused by inadequate communication and both of those involved the use of CPDLC and the misinterpretation of the “Cleared to via” message. One event was caused by an aircraft avoiding adverse weather.

Considering the high safety criticality of the “Restricted airspace infringement” incidents, it is suggested to retain it as a safety priority.

4.6 Altitude deviation events

Figure 4-6: Altitude deviation events

Figure 4-6 provides insight into the specific initiators of the altitude deviation incidents. The following was identified:

- Altitude deviation was the third most common initiator in the 2024 en-route sample (9 events).
- Most of these events (7 out of 9) penetrated the “ATC collision avoidance” barrier.
- Two thirds of these events (6 out of 9) were caused by miscommunication. The others were caused by various other factors: an ACAS RA manoeuvre, a wrong altimeter setting and inability to comply with the ATC clearance due to technical issues.

Considering the safety criticality of the “Altitude deviation” incidents, it is suggested altitude deviation to be monitored for the risk associated with it.

4.7 Contextual factor analysis – En route

This section presents the results of the analysis of the typical contextual factors, for which information was available in the description of the occurrences included in the 2024 en-route data sample. Several contextual factors were selected for their significance, including: workload, weather, HOTO, CPDLC, flights without a transponder or with a dysfunctional one and unconcerned colour of tracks and labels.

4.7.1 Workload

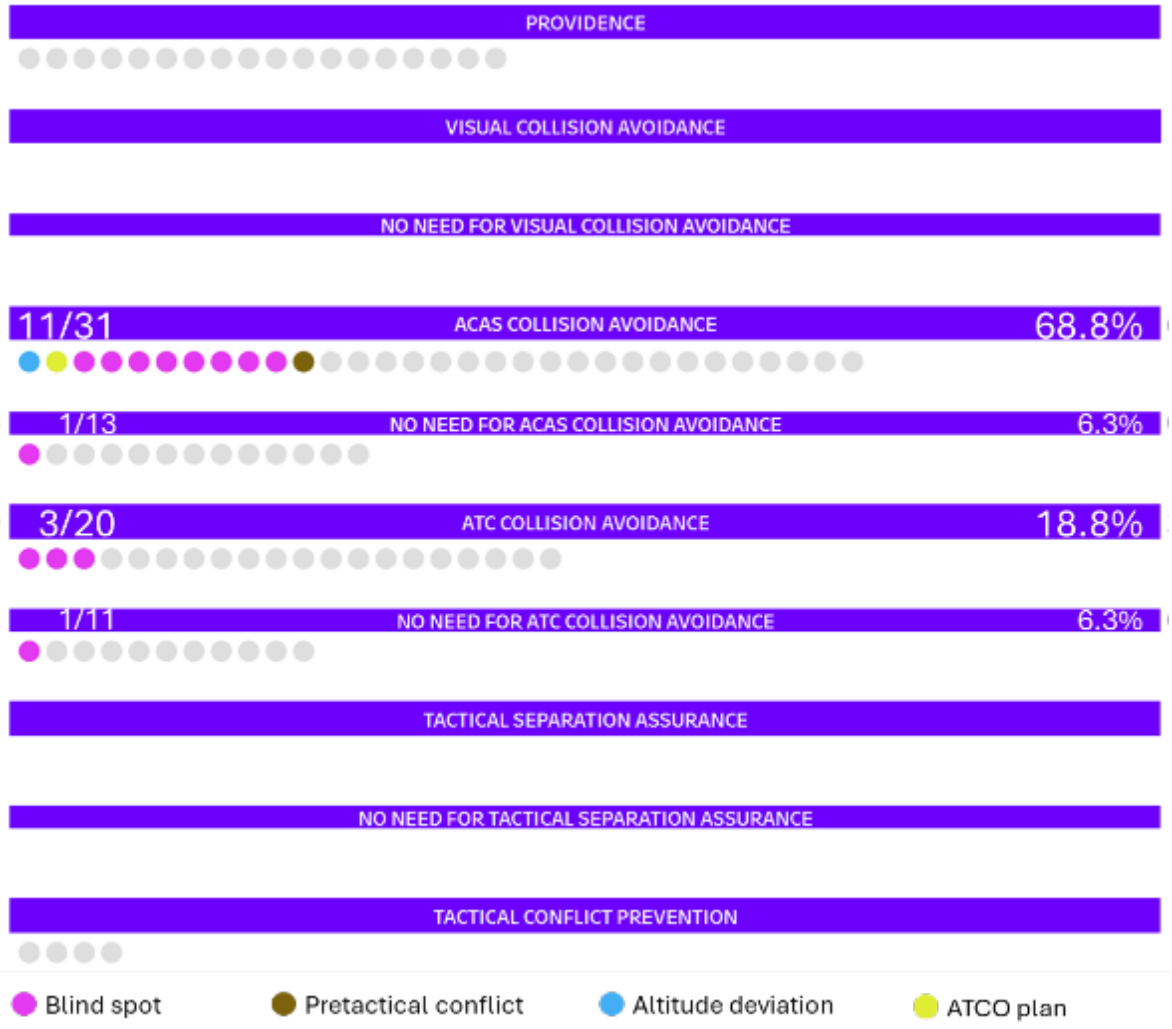

Figure 4-7: High workload/overload

Figure 4-7 shows events where high workload/overload was reported. The following was identified:

- High workload/overload was reported in 16% of the events in the sample (16 out of 97).
- More than 80% (13 out of 16) of the incidents with reported high workload/overload originated from a blind spot event.
- 75% (12 out of 16) of the events penetrated all ATC-based barriers.

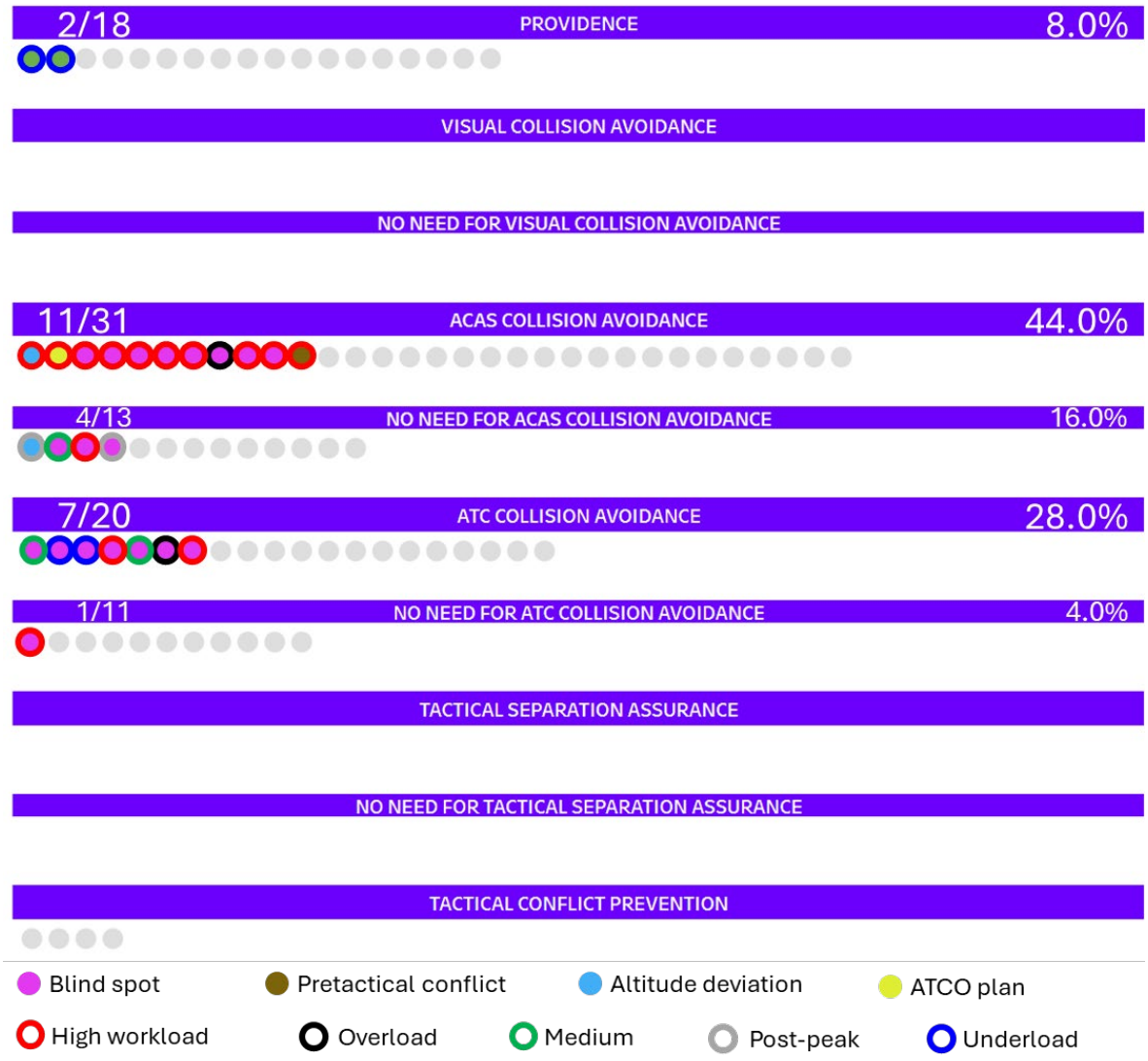

Figure 4-8: Workload (all types)

Figure 4-8 shows all events where the workload situation was reported. The following was identified:

- High workload/overload was reported in 16 events.
- Workload other than high/overload was reported in 9 events.
- In four events underload was reported. In two of those, all barriers up to “Providence” were penetrated.
- Post-peak workload was reported in two events. In both cases, the “ATC collision avoidance” barrier was penetrated.
- Medium workload was reported in three events. Two of those were stopped at the “ATC collision avoidance” barrier and for the third there was no need for ACAS collision avoidance.

Considering the significance of the incidents associated with high workload, it is suggested high workload to be monitored for the risk associated with it.

4.7.2 Weather

Figure 4-9: Weather

The 2024 sample contains 9 events where weather avoidance was identified as a factor. The following was identified:

- In most cases (8 out of 9) the initiator was a blind spot event.
- More than half of the incidents (5 out of 9) penetrated the “ATC collision avoidance” barrier.

Considering the prominence of the incidents associated with weather avoidance, it is suggested that this factor is noted in the report.

4.7.3 Handover-takeover (HOTO)

Figure 4-10: Handover-takeover (HOTO)

The 2024 sample contains 9 events where handover-takeover (HOTO) was identified as a factor. The following was identified:

- In two thirds of the cases (6 out of 9) the initiator was a blind spot event.
- In two of the cases there was a restricted airspace infringement. In these cases all barriers up to “Providence” were penetrated.
- Two thirds (6 out of 9) of the incidents penetrated the “ATC collision avoidance” barrier.

Considering the prominence of the incidents associated with HOTO, it is suggested that this factor is noted in the report.

4.7.4 CPDLC

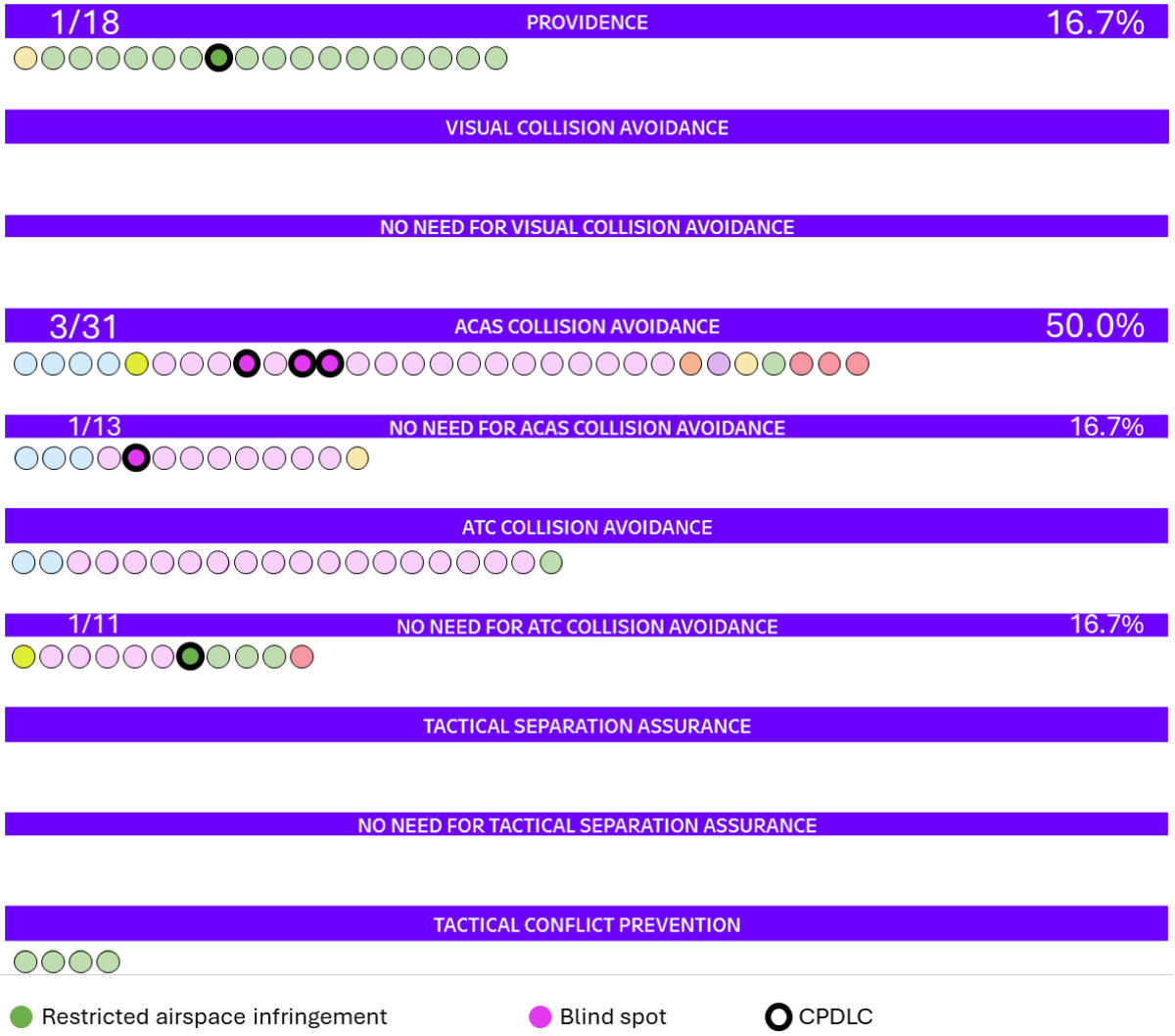

Figure 4-11: CPDLC

The 2024 sample contains 6 events where CPDLC was identified as a factor. The following was identified:

- In 4 cases the use of CPDLC was mentioned in losses of separation initiated by a blind spot event.
- In 2 cases the use of CPDLC was mentioned in restricted airspace infringement events.
- Most of the events (5 out of 6) penetrated the “ATC collision avoidance” barrier.

Considering that CPDLC is a relatively newly implemented technology, it is suggested that this factor is noted in this report.

4.7.5 Flights without a transponder or with a dysfunctional one

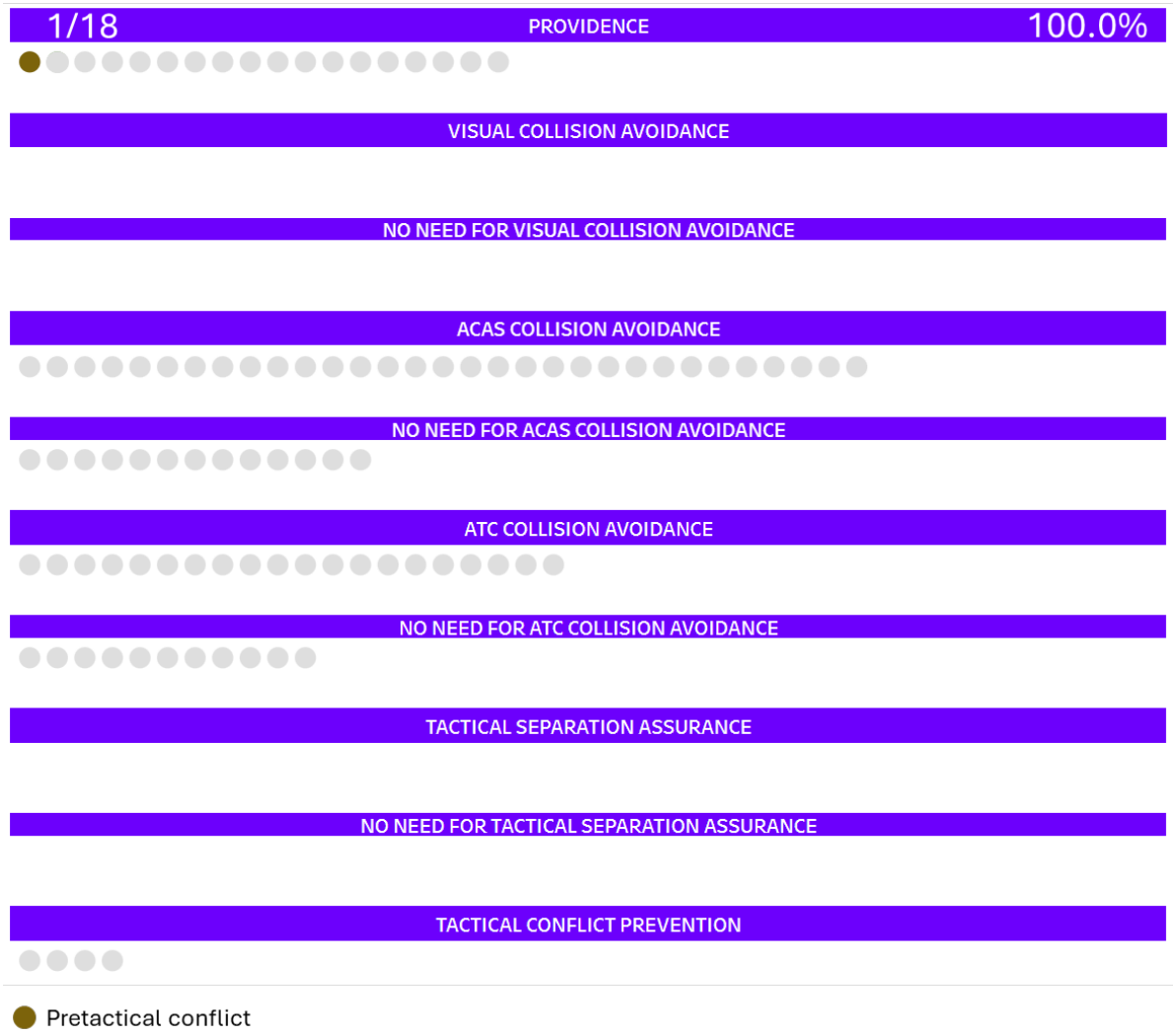

Figure 4-12: Flight without a transponder or with a dysfunctional one

In the 2024 sample there was only one event involving a flight without a properly operating transponder. However, this occurrence demonstrated again that lack of transponder data allows for penetration of all safety barriers until “Providence”.

Considering the criticality of flights without a transponder or with a dysfunctional one, it is suggested to retain “Flight without a transponder or with a dysfunctional one” as a safety priority.

4.7.6 Unconcerned colour

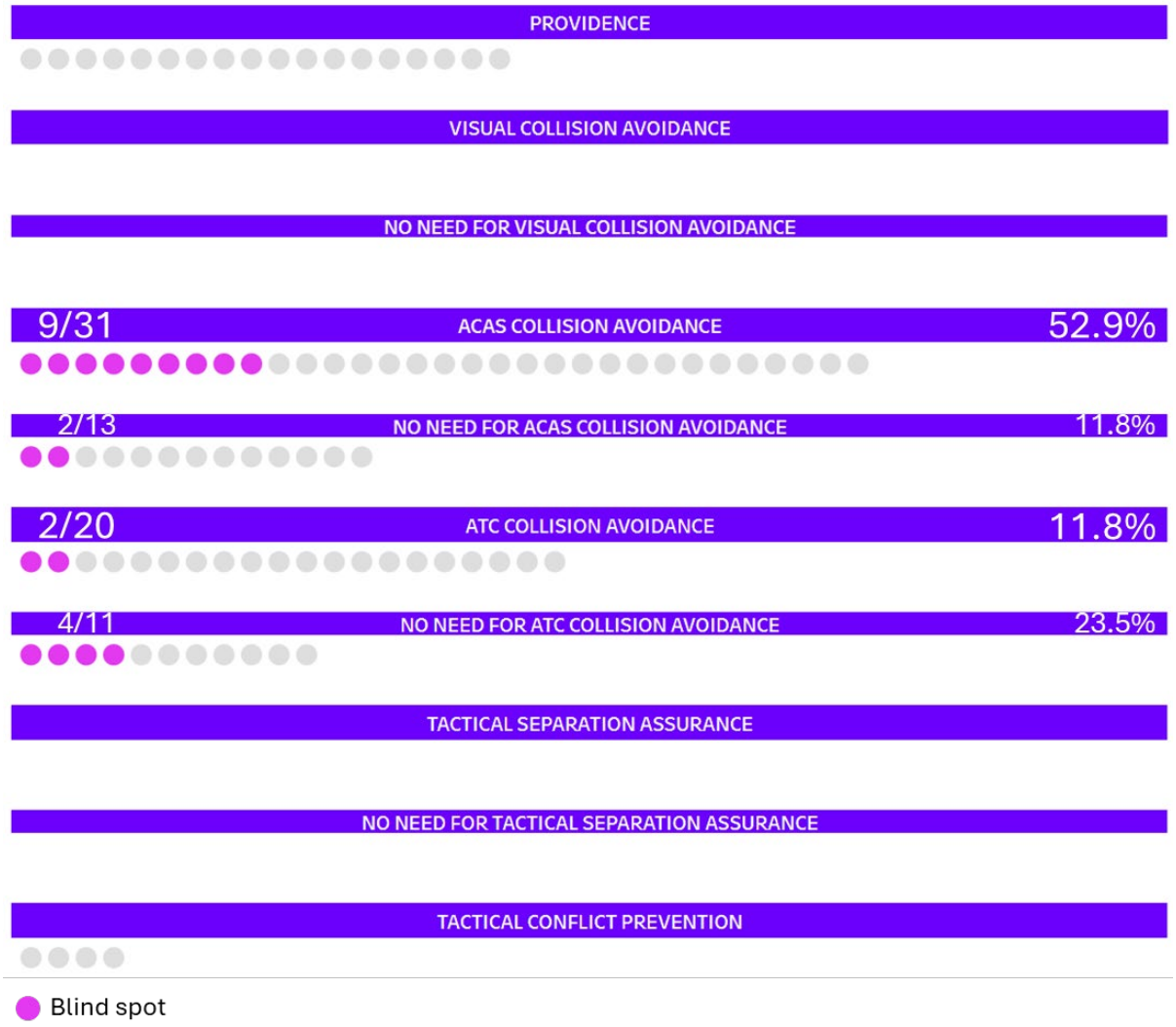

Figure 4-13: Tracks in unconcerned colour

Figure 4-13 shows events where the participating aircraft's tracks and labels were in "unconcerned" colour making them harder to recognize as a risk factor. The following was identified:

- In all of the 17 cases the event initiator was "blind spot.
- Almost two thirds (11 out of 17) of the events penetrated all ATC-based barriers.

Considering the prominence of the incidents associated with tracks in unconcerned colour, it is suggested that this factor is noted in the report.

4.7.7 Blind spot and 1000 ft vertical separation

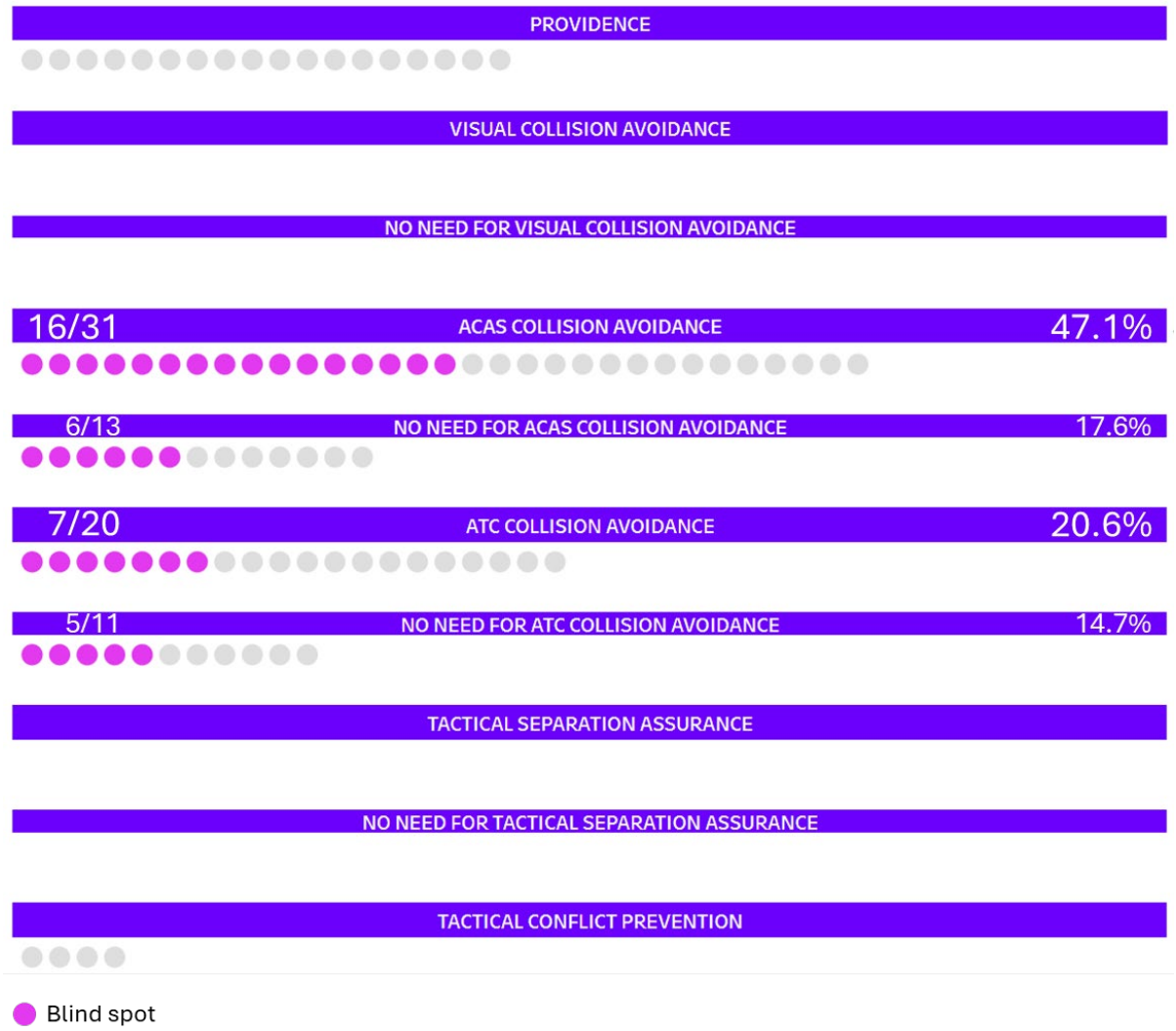

Figure 4-14: Blind spot and 1000 ft separation

Figure 4-14 shows blind spot events where the vertical separation between the aircraft was 1000 ft. The following was identified:

- This combination accounted for more than two thirds (34 out of 50) of all blind spot events.
- Almost two thirds of these events (22 out of 34) penetrated the “ATC collision avoidance” barrier.

4.7.8 Blind spot and aircraft not within sector airspace

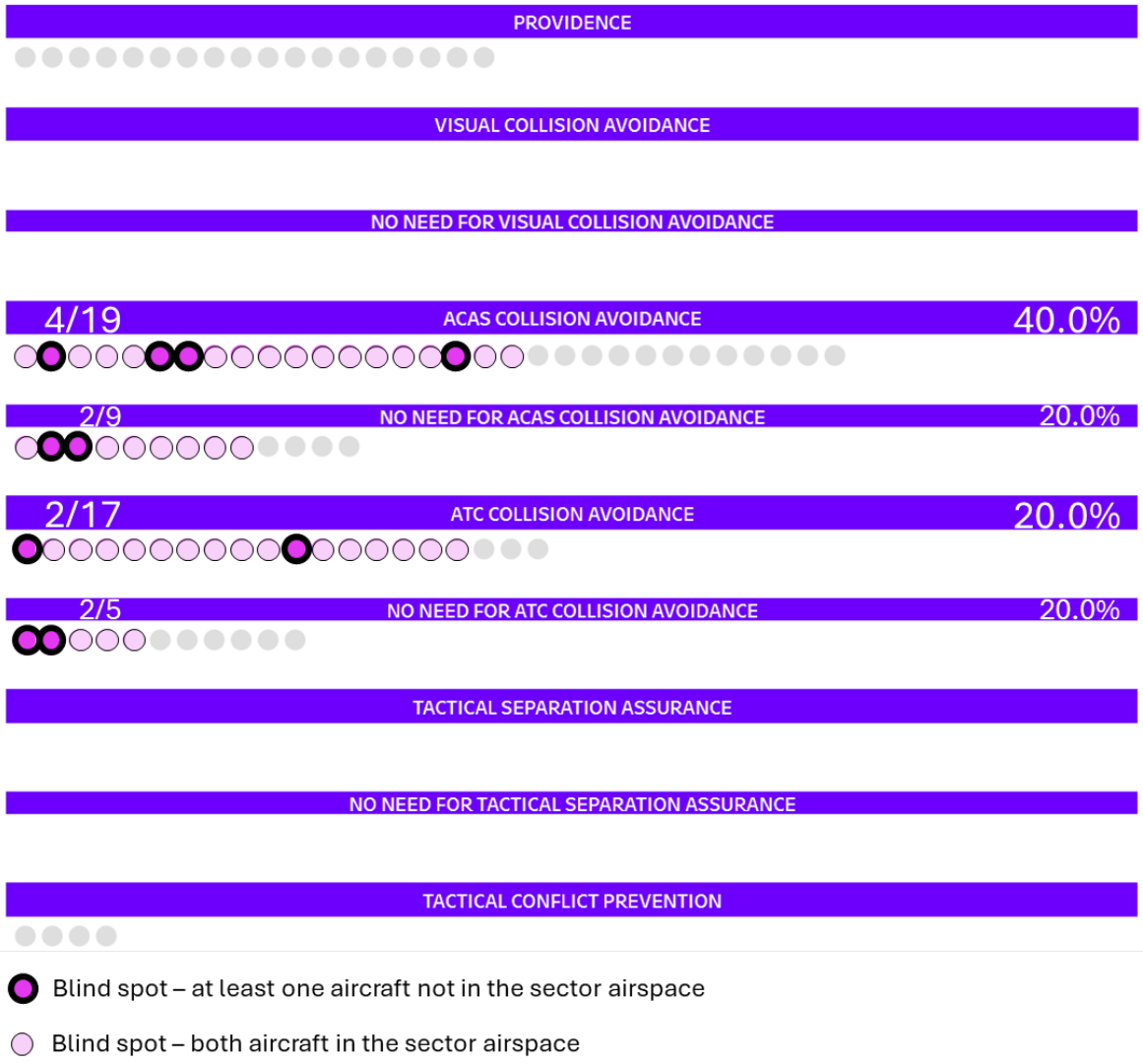

Figure 4-15: Blind spot and aircraft not within sector airspace

Figure 4-15 shows blind spot events where at least one of the aircraft was not within the sector's airspace. The following was identified:

- This combination accounted for 20 % (10 out of 50) of all blind spot events.
- More than half of these events (6 out of 10) penetrated the "ATC collision avoidance" barrier.

4.7.9 Blind spot and high workload/overload

Figure 4-16: Blind spot and high workload/overload

Figure 4-16 shows blind spot events where high workload or overload was reported. The following was identified:

- This combination accounted for about a quarter (13 out of 50) of all blind spot events.
- More than two thirds of these events (9 out of 13) penetrated the “ATC collision avoidance” barrier.

4.7.10 Blind spot and opposite direction conflicts

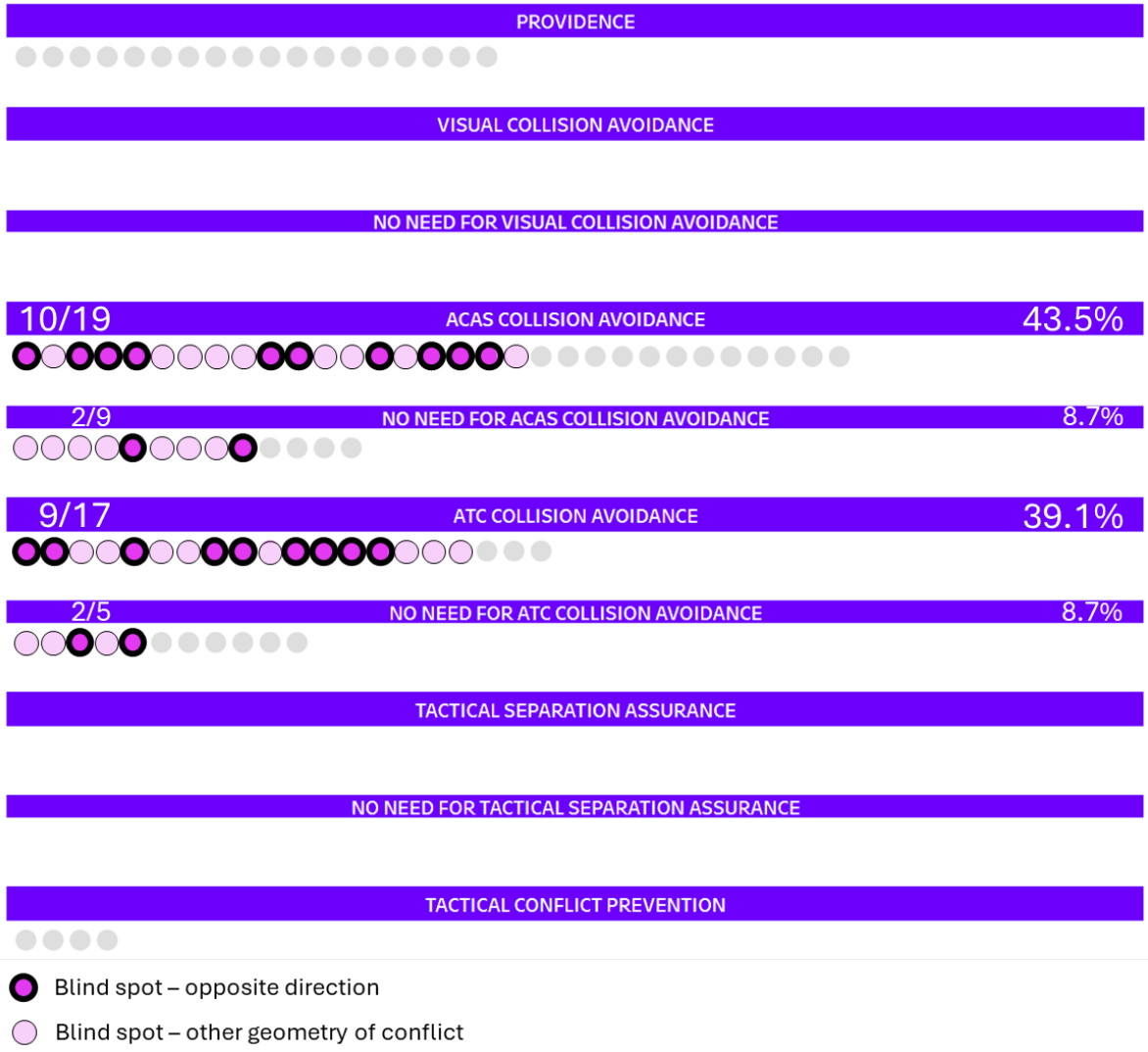

Figure 4-17: Blind spot and opposite direction conflicts

Figure 4-17 shows blind spot events where the conflicting aircraft were flying in opposite directions. The following was identified:

- This combination accounted for almost half (23 out of 50) of all blind spot events.
- A little more than half of these events (12 out of 23) penetrated the “ATC collision avoidance” barrier.

4.7.11 Restricted airspace infringement and direct routing

Figure 4-18: Restricted airspace infringement and direct routing

Figure 4-18 shows restricted airspace infringement events where an aircraft was cleared to fly on a direct routing. The following was identified:

- This combination accounted for 41% (11 out of 27) of all restricted airspace infringement events.
- A almost three quarters of these events (8 out of 11) penetrated all barriers but “Providence”.
- This combination accounted for almost half (8 out of 17) restricted airspace infringement events that were stopped at the “Providence” barrier.

5 TMA/CTR Separation Minima Infringements – Summary Analysis

5.1 Overall barrier performance – TMA/CTR

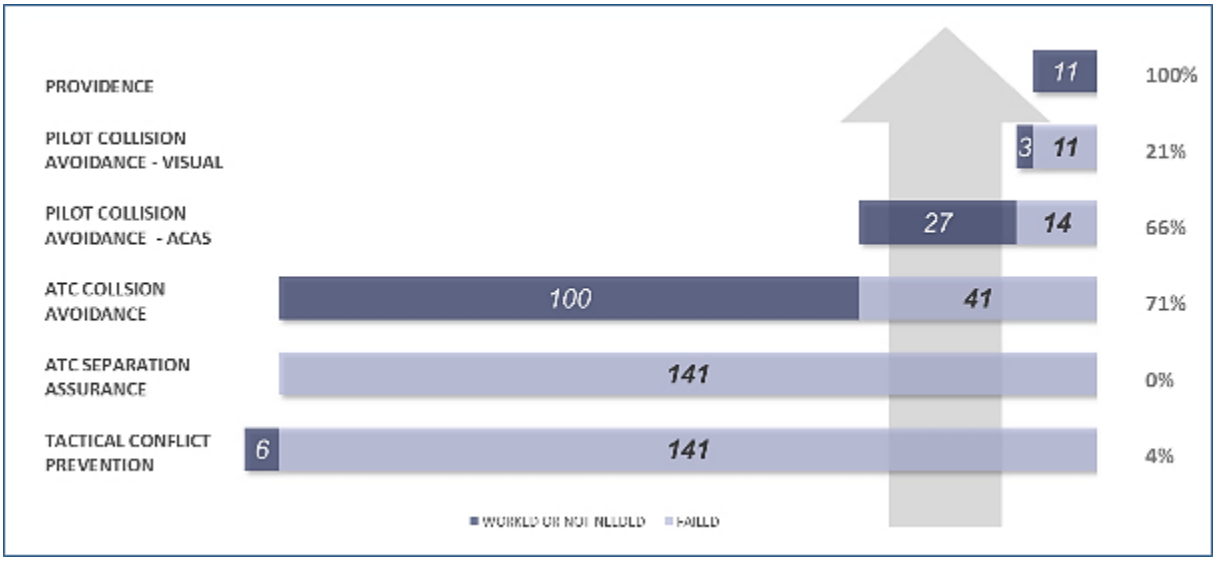

Figure 5-1: Overall barrier performance

- Performance of the basic barrier “Tactical conflict prevention”: challenged 147 times, failed in 141 cases (96%) and worked in 6 cases (4% success). This is not a surprise, due to the high severity (A and B) of the events included in the analysed data sample. To obtain more reliable information about the barrier strength, incidents of lower severity (e.g. C, D and E) should be analysed, too.
- Performance of the basic barrier “ATC separation assurance”: challenged 141 times, failed in all 141 cases. To obtain a more reliable information about the barrier strength, incidents of lower severity (e.g. C, D and E) should be analysed, too.
- Performance of the basic barrier “ATC collision avoidance”: challenged 141 times, failed in 41 cases (29%) and worked or was not needed in 100 cases (71% success).
- Performance of the basic barrier “Pilot collision avoidance - ACAS”: challenged 41 times, failed in 14 cases (34%) and worked or was not needed in 27 cases (66% success). In all 11 events this basic safety barrier failed, the ACAS system was unavailable for various reasons.
- Performance of the basic barrier “Pilot collision avoidance - visual”: challenged 14 times, failed in 11 cases (79%) and worked or was not needed in 3 cases (21% success).
- Performance of the basic barrier “Providence”: challenged 11 times, worked or was not needed in all cases (100% success).

5.2 Performance of first barrier "Tactical Conflict Prevention"

Figure 5-2 below shows the distribution of the failure scenarios for the first barrier.

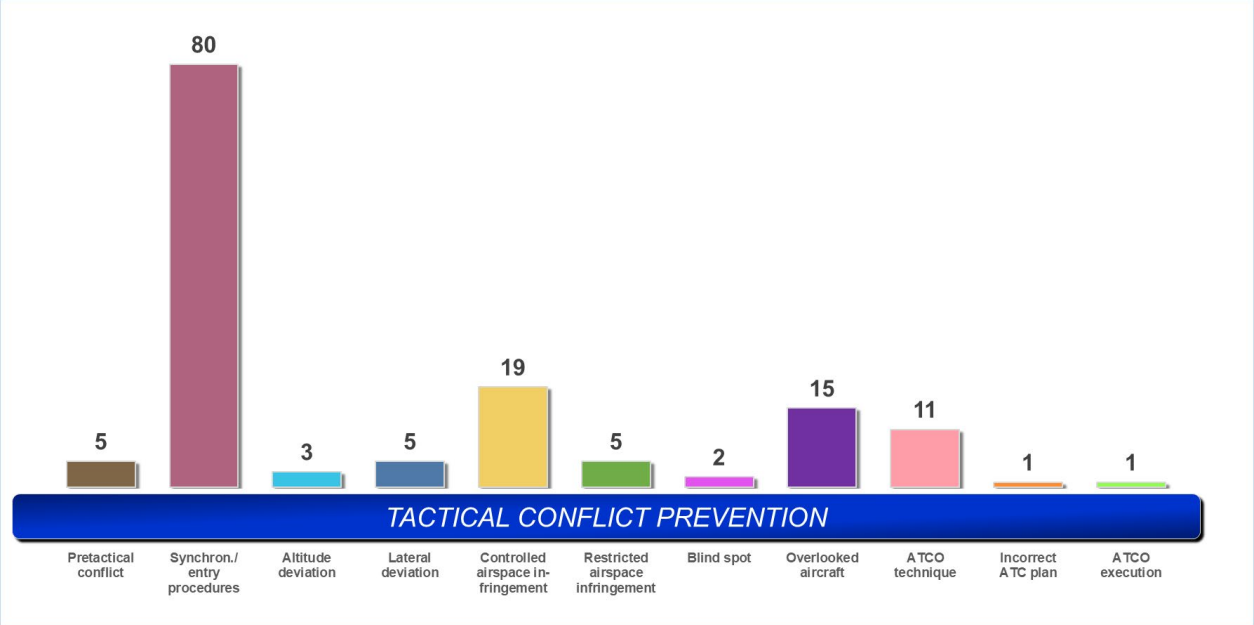

Figure 5-2 : Separation minima infringement scenarios and initiators

The SAFMAP analysis helped identify the following initiating factors that played a role in the 2024 occurrence data sample:

- In 80 incidents (54% of the data sample) the conflict was generated by "ATC tactical planning and traffic synchronisation". This initiator's share has risen from around 45% in the previous two years.
- In 19 incidents (13% of the data sample) the conflict was generated by "Controlled airspace infringement".
- In 15 incidents (10% of the data sample) the conflict was generated by "Overlooked aircraft".
- In 11 incidents (7% of the data sample) the conflict was generated by "Controlled airspace infringement".
- In 7 incidents (7% of the data sample) the conflict was generated by "Incorrect ATCO techniques". This factor also contributed to 38% of the traffic synchronisation events, adding up to an overall share of 28% in the analysed data sample.
- In 5 incidents (3% of the data sample) the conflict was generated by "Pre-tactical conflict" that was not dealt with timely by ATCO.
- In 5 incidents (3% of the data sample) the conflict was generated by "Lateral deviation".
- In 5 incidents (3% of the data sample) the conflict was generated by "Restricted airspace infringement".
- In 3 incidents (2% of the data sample) the conflict was generated by "Altitude deviation".
- In 2 incidents (1% of the data sample) the conflict was generated by controller "Blind spot".

- In 1 incident (1% of the data sample) the conflict was generated by “Incorrect ATCO plan”. This factor also contributed to 10% of the traffic synchronisation events, adding up to an overall share of 6% of the analysed data sample.
- In 1 incident (1% of the data sample) the conflict was generated by “Incorrect ATCO execution”.

5.3 Barriers' resilience per initiator

Figure 5-3: Barrier resilience per initiator

Figure 5-3 illustrates the distribution of incidents that were stopped by a barrier and those that crossed it, as well as the resilience of the barriers to the different initiators. The following can be concluded regarding the barrier effectiveness:

- The share of events stopped at each basic barrier in 2024 has remained similar to the previous two years, except for an increased effectiveness of the first basic barrier "Tactical conflict prevention", and a slight decrease of the higher tier barriers' effectiveness that can be explained by a rising number of drone-related incidents.
- The majority of events were stopped at the "ATC collision avoidance" barrier - 68% - consistent with the previous two years.
- 7.5% of all incidents reached the last barrier "Providence", slightly increasing from 6% in 2023 and 4% in 2022. This negative progression can be explained by a rise of drone infringements of final approach areas only identified by aircraft pilots as they passed by them.
- 2% (3) of incidents were stopped at "Pilot collision avoidance – visual", 2/3 requiring pilot visual collision avoidance action.
- 18% of incidents were stopped at the "Pilot collision avoidance – ACAS" barrier.
- 4% of incidents were stopped at the first basic barrier "Tactical conflict prevention" – compared to none in the previous two years.
- The initiator with the highest safety criticality remains the same from the previous two years - "Controlled airspace infringement" – with a share of 79% of all events in the data sample that reached the last two barriers (up from 55% in 2023).
- 11 events of airspace infringement reached the last barrier 'Providence'. These include 10 CAS infringements – of which 9 drone encounters – and 1 restricted airspace infringement.

- The ATC barriers could not prevent and resolve 86% of the airspace infringements conflicts.
- "Restricted airspace infringement" events have decreased in safety criticality in 2024: owning a share of 7% of the events that reached the last two barriers, down from 27% in the previous year.
- The largest initiator, "ATC tactical planning and traffic synchronisation" has remained largely the same in terms of safety criticality over the last three years.
- Lateral deviations have somewhat decreased in terms of safety criticality from the previous year with 2/3 of the events reaching the "Pilot collision avoidance – ACAS" barrier (same as in 2023).
- "Incorrect ATCO technique" is a significant event initiator with a share of 28% in the analysed data sample (41 events in total, including the synchronisation events involving use of inappropriate techniques), however of moderate safety criticality – only 5 events (12%) reached and were stopped at the ACAS collision avoidance barrier.
- 27% of "Overlooked aircraft" events passed through all ATC barriers (and most of those were stopped at the "ACAS collision avoidance" barrier).

5.4 Controlled airspace infringement incidents

Figure 5-4: Controlled airspace infringement incidents

Figure 5-4 provides insight into the controlled airspace infringement incidents. The following was identified:

- Controlled airspace infringement is the most safety critical initiator in 2024.
- Over half of controlled airspace infringements (58%) reached the last two barriers, comprising most (79%) of all the events in the sample that did so.
- They account for 10 out of the 11 events in the sample that were only stopped by 'Providence' (9 of which were drone encounters).
- 53% (10 out of 19) of controlled airspace infringements were caused by drones, thus:
  - The conflict was undetectable, and ATC tactical separation assurance and collision avoidance were unavailable.
  - ACAS collision avoidance was unavailable (drones were not transponder equipped).
  - Visual collision avoidance was unavailable, except in 1 event when the pilot of a departing aircraft observed the drone and took timely avoiding action.
- 32% of the events were due to incorrect aircraft navigation.
- 11% were due to inadequate ATS coordination.
- 5% were due to use of inappropriate/obsolete aeronautical information.
- 42% involved VFR flights.
- 21% involved non-commercial flights.
- In 11% poor ATC teamwork was a factor.

Considering high safety criticality in the 2024 sample, it is suggested to retain "Controlled Airspace Infringement" as a safety priority.

5.5 ATC tactical planning and synchronisation incidents

Figure 5-5: Incorrect ATC traffic synchronisation / entry procedures

Figure 5-5 provides insight into the largest TMA/CTR incident initiator in 2024: incorrect traffic synchronisation by ATC. The following was identified:

- 54% of all events in the data sample were initiated by incorrect ATC traffic synchronisation and they have remained largely the same in terms of safety criticality in the last three years.
- 83% of incorrect traffic synchronisation events were stopped at the “ATC collision avoidance barrier” (roughly the same as in the previous two years). A three-year trend of a shift towards no need for active ATC collision avoidance action can be observed (51% vs 37% vs 26% of the conflicts going back each year). These are mostly events associated with conflicting interceptions of parallel localisers (FATs), after which the conflict (separation infringement) is resolved by the aircraft establishing on the parallel finals.
- 16% of the events were stopped at “Pilot collision avoidance – ACAS”. Shift towards the need for ACAS manoeuvres over the last two years can be observed (11% in 2022).
- 58% of the events involved inadequate synchronisation of arriving to land aircraft.
- 26% involved conflict between a departing and an arriving aircraft.
- 16% involved inadequate synchronisation of successive departing aircraft.
- The largest contributing factors are:
  - 38% incorrect interception of final approach path (arrivals),
  - 38% inadequate ATCO controlling techniques, including vectoring, speed management and rate of change management (all),
  - 10% go-around conflict (mixed).

- In 44% of incorrect traffic synchronisation events ATCO did not assure tactical separation due to flawed decision/goals (2nd basic barrier).
- In 26% of events, ATC detected the separation minima infringement late (including the 18% detected with the aid of STCA).
- In 23% ATC detected the conflict too late to prevent separation infringement but in time to issue successful collision avoidance instruction.
- In 16% there was insufficient time for separation assurance by ATC.
- 58% occurred during sequencing for final approach.
- In 29%, the ATCO identified the conflict after STCA.
- In 10%, a flown missed approach/go-around was a contributing factor.
- 9% occurred during high ATC workload.

In view of the above it is suggested to continue monitoring the risk associated with "Synchronisation of successive arriving to land and of arriving to land and departing aircraft".

5.6 Incorrect ATCO techniques

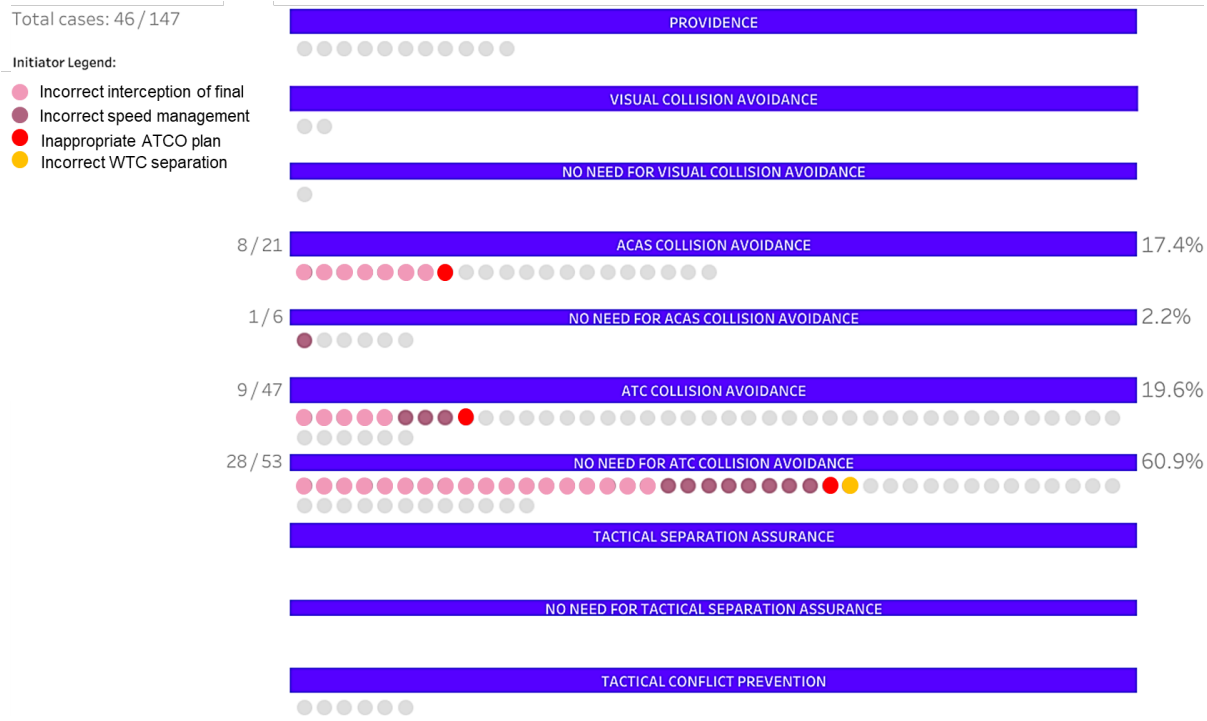

Figure 5-6: Events initiated by incorrect ATCO techniques

- Use of incorrect ATCO techniques contributed to 30 events of the incorrect traffic synchronization events (38%) and to further 11 events, adding up to 41 events overall and 28% of the studied data sample (same as in the previous year's sample).
- These events were initiated by:
  - Incorrect speed management when synchronising arriving aircraft in 29% of incidents (12).
  - Incorrect ATCO techniques when synchronising departing aircraft in 24% (10 incidents).
  - 20% (8 events) of incorrect ATCO techniques when synchronising arriving and departing aircraft in 20% (8 incidents)
  - Inappropriate vectoring in 20% (8 incidents).
  - Inadequate rate of change (climb/descent) control in 5% (2 incidents).
  - The issue with the techniques was not specified in 2% (1 incident).
- The majority of events (88%) were stopped at the "ATC collision avoidance" barrier.
- In just over half of all events, there was no need to ATC collision avoidance.
- In 41% ATCO detected the conflict after STCA.
- In 41% ATCO did not prevent separation infringement due to flawed decision/goals (ATCO took decision not to intervene).
- 34% occurred during sequencing for final approach.
- In 27% of the events, although separation infringement was not prevented, ATCO's action were sufficient to prevent a collision.

- 12% involved aircraft climbing in conflict with another aircraft descending.
- 12% involved non-commercial transport flight.

Considering the prominence of the incidents involving incorrect ATCO techniques, it is suggested that this factor is noted in the report.

5.7 Overlooked aircraft incidents

Figure 5-7: Overlooked aircraft incidents

Figure 5-7 provides insight into the events initiated by ATCO overlooking aircraft and issuing conflicting clearances. The following was identified:

- Overlooked aircraft incidents make up 10% (15) of all events in the data sample.
- 20% (3 incidents) occurred after ATCO distraction.
- The distribution across barriers of overlooked aircraft events in 2024 is similar to 2022 (there was only 1 event in 2023), with an increase in safety criticality: 1 event reached the “Pilot Collision Avoidance – Visual” barrier in 2024.
- 20% of the events reached the “Pilot Collision Avoidance – ACAS” barrier (same as in 2022).
- 2/3^{rds} of the conflicts were detected too late – 60% with the help of STCA – to prevent the separation infringement.
- In 47%, ATCO’s actions were sufficient to prevent a collision despite not detecting the conflict in time to prevent separation infringement.
- In 13% of the events, the ATCO did not detect the conflict.
- In 47% the aircraft were not under control of one and the same sector.
- 20% factored adverse weather conditions.
- 13% occurred during sequencing for final approach.
- 13% involved aircraft climbing in conflict with another aircraft descending.

5.8 Contextual factor analysis – TMA/CTR

This section presents the results of the analysis of the typical contextual factors, for which information was available in the description of the occurrences of separation minima infringements in TMA/CTR airspace included in the 2024 data sample. Several contextual factors were selected for their significance in the analysed event sample, including: occurrence during sequencing for final approach, non-commercial flight involved, VFR flight involved, ACAS unavailability, adverse weather reported, and high controller workload.

5.8.1 Incidents during sequencing for final approach

Figure 5-8: During sequencing for final approach

Figure 5-8 illustrates the incidents that occurred during sequencing for final approach. The following can be noted:

- The incidents which occurred during sequencing for final approach account for 37% of 2024's data sample.
- Most (78%) events were stopped at "ATC collision avoidance", 20% were stopped at "Pilot collision avoidance – ACAS" and 1 event reached "Pilot collision avoidance – Visual".
- Most (84%) of the incidents were initiated by incorrect "ATC tactical planning and traffic synchronisation".
- In 42%, ATCO detected the conflict late (in 31% after STCA).
- In 18%, ATC detected the conflict too late to prevent separation infringement but in time to issue successful collision avoidance instruction.
- 9% occurred during high controller workload.

5.8.2 Incidents involving non-commercial flights

Figure 5-9: Non-commercial flights involved

Figure 5-9 illustrates the incidents associated with reported non-commercial flight involvement. The following can be noted:

- 10% of the events in the analysed sample included non-commercial flight participation – roughly half of the previous two years' samples, which marks a significant decrease.
- 33% of the incidents with non-commercial flight participation passed all ATC barriers: down from 43% in 2023 and 37% in 2022.
- 21% of the events in the sample that reached the last two barriers involved non-commercial flights (compared to over half in the previous year).
- In 1/3rd of events ATC detected the conflict late (in 20% after STCA).
- In 1/3rd of events ATCO's actions were sufficient to prevent a collision despite not detecting the conflict in time to prevent the separation infringement.
- In 40% the flight was conducted according to the VFR.
- In 20% ACAS was unavailable.
- 13% involved high traffic complexity.
- 13% factored in inadequate ATC teamwork.
- 13% occurred while aircraft were cleared on heading/direct.

It is suggested to keep monitoring the risk associated with non-commercial flights due to their safety criticality (particularly during the previous two years).

5.8.3 Incidents with reported adverse weather

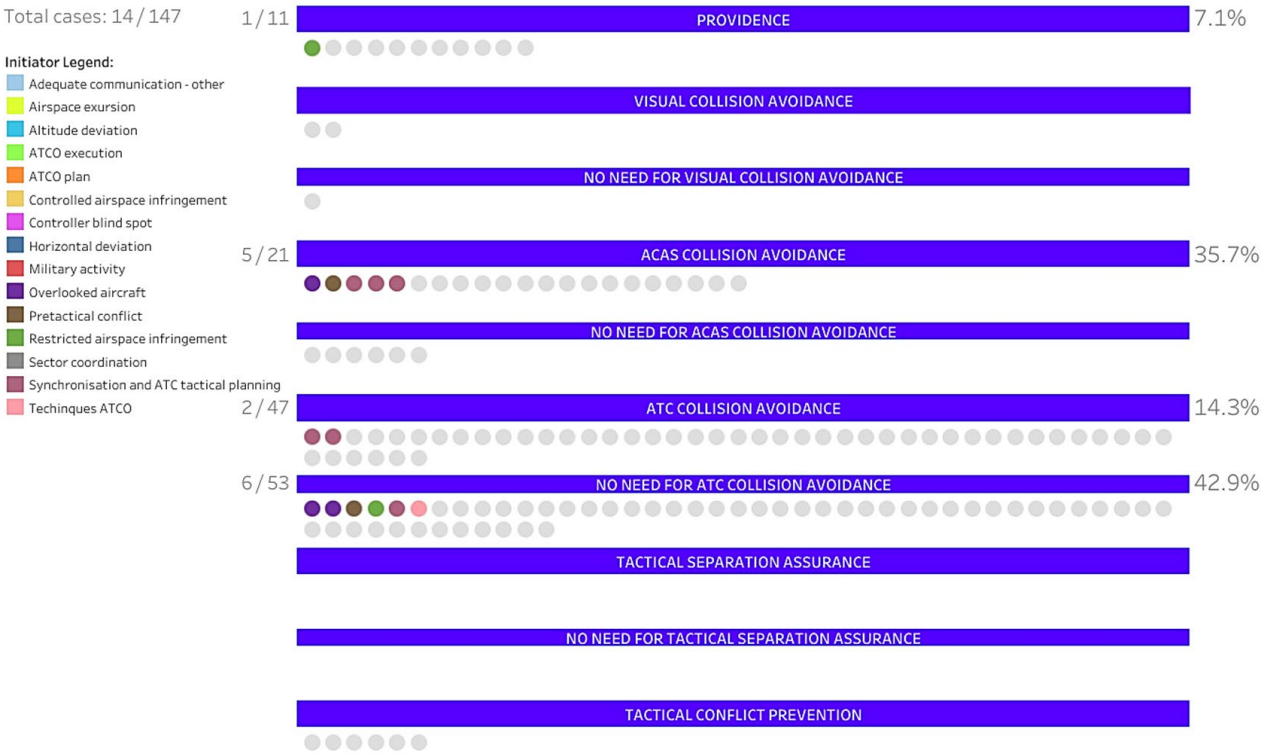

Figure 5-10: Incidents factoring in convective weather

Figure 5-10 illustrates the incidents associated with reported convective weather. The following can be noted:

- The incidents in which adverse weather was reported constitute 10% of the analysed sample.
- The incidents in which adverse weather was reported are of relatively high safety criticality as almost half (6 out of 14) of them crossed all ATC barriers, including 1 event that reached the “Providence” barrier.
- 29% occurred during sequencing for final approach.
- 14% (2 out of the 14 events) involved high traffic complexity.
- In 14%, issues with system support were reported.
- 14% factored in inadequate ATC teamwork.
- 14% involved a missed approach / go-around conflict.
- 14% involved aircraft climbing in conflict with another aircraft descending.

5.8.4 Airborne Collision Avoidance System (ACAS) not available

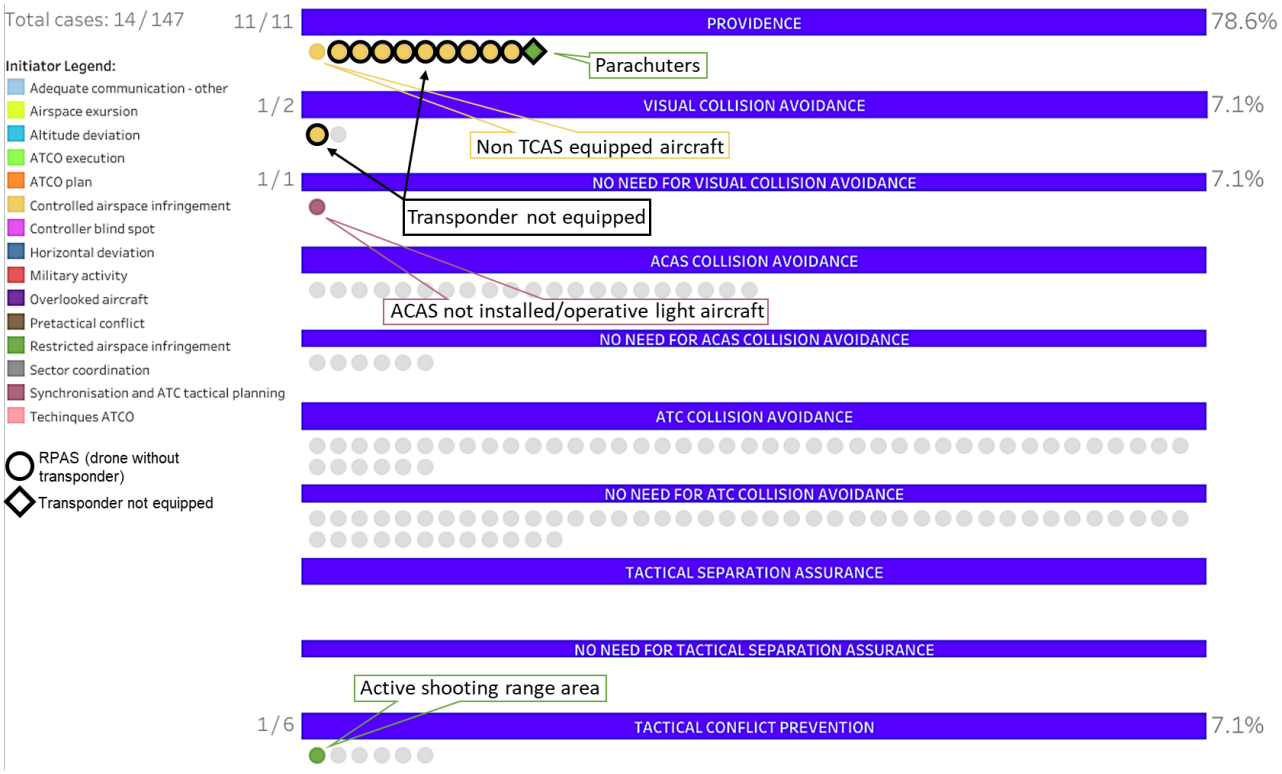

Figure 5-11: ACAS unavailable

Figure 5-11 illustrates the incidents associated with reported ACAS unavailability. The following can be noted:

- The ACAS barrier was unavailable in 10% of the studied sample.
- Logically, cases in which ACAS is not available are of high safety criticality. The events in this group encompass all but one events that reached the last two barriers (similarly, all events in the previous two years).
- 58% of restricted airspace infringements fall into this category.
- In the majority (79%) of these events, ATC tactical separation assurance and ATC collision avoidance were also unavailable.
- In 71%, pilot visual collision avoidance was unavailable.
- Much of this can be explained by the lack of transponder in 79% of cases, including 10 non-equipped drone events (71%).
- 14% involved VFR flights.

Due to the safety criticality of the events involving ACAS unavailability, in particular due to not transponder equipped flights (drones) it is suggested to retain "Operation without a transponder" as a safety priority.

5.8.5 Incidents involving VFR flights

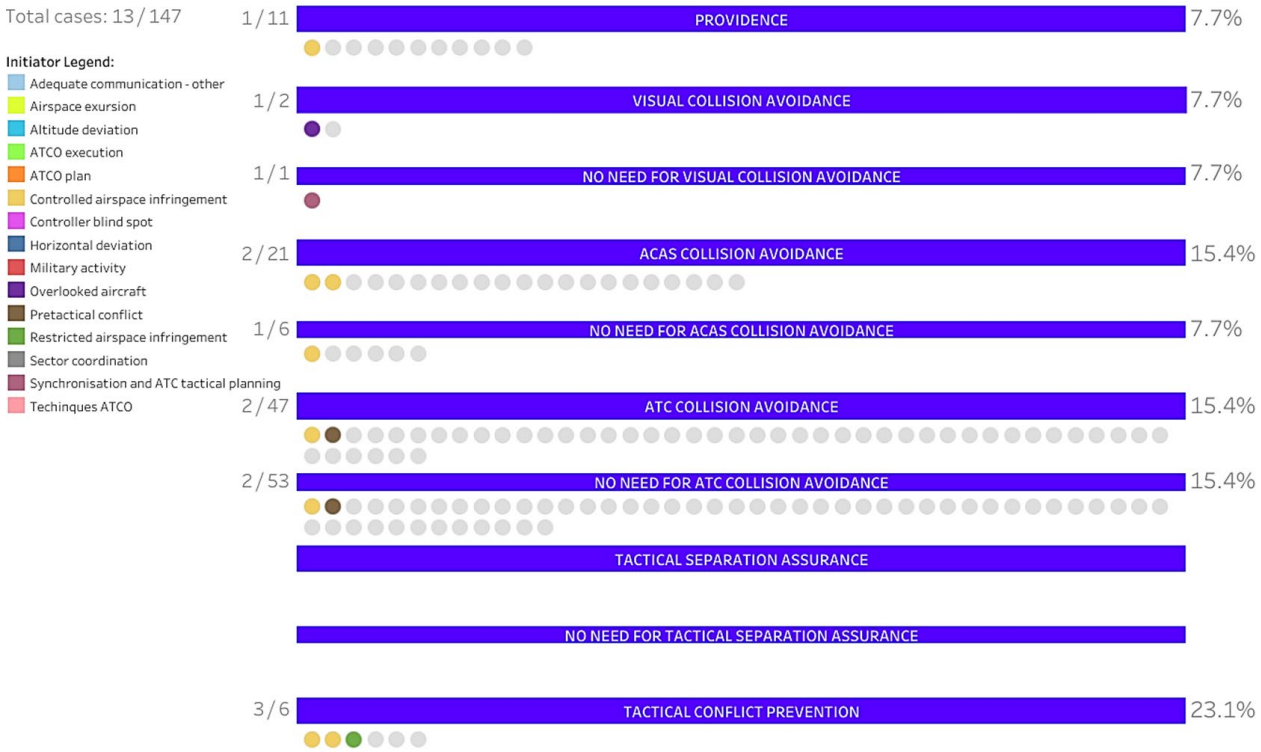

Figure 5-12: VFR flights involved

Figure 5-12 depicts the incidents in which VFR flight took part. The following can be noted:

- Incidents involving VFR flights account for 9% of the analysed sample.
- ATC barriers stopped 54% of VFR flight incidents, as in the previous two years. Even so, incidents involving VFR flights remain of relatively high safety criticality.
- Incidents involving VFR flight constitute 42% of all controlled airspace infringement events (same as in the previous year).
- 15% involved aircraft cleared on heading/direct.
- 15% factored in inadequate ATC teamwork.
- 15% occurred during ATCO on-the-job training.

Considering the safety criticality of the incidents involving VFR flights it is suggested that this factor is noted in the report.

5.8.6 High ATC workload incidents

Figure 5-13: High controller workload

Figure 5-13 depicts the incidents involving high controller workload. The following can be noted:

- High controller workload was reported in 8% of the studied data sample.
- The largest initiator in this grouping of events is “ATC tactical planning and synchronisation” (7 out of 12 events).
- 42% of incidents involving high controller workload crossed all ATC barriers – with most stopped by ACAS collision avoidance and 1 event reaching the “Providence” barrier.
- In 1/3rd of the events, ATCO detected the conflict after STCA.
- 42% (5 out of 12 events) occurred during sequencing for final approach.
- In 42%, ATCO’s actions were sufficient to prevent a collision despite not detecting the conflict in time to prevent the separation infringement.
- In 1/3rd of the events, traffic complexity was high.
- In 25% (3 out 12 events) adverse weather was reported.
- 17% (2 out of 12 events) involved a grouped sector.

6 Runway Incursion Incidents – Summary Analysis

6.1 Overall barrier performance – runway incursion

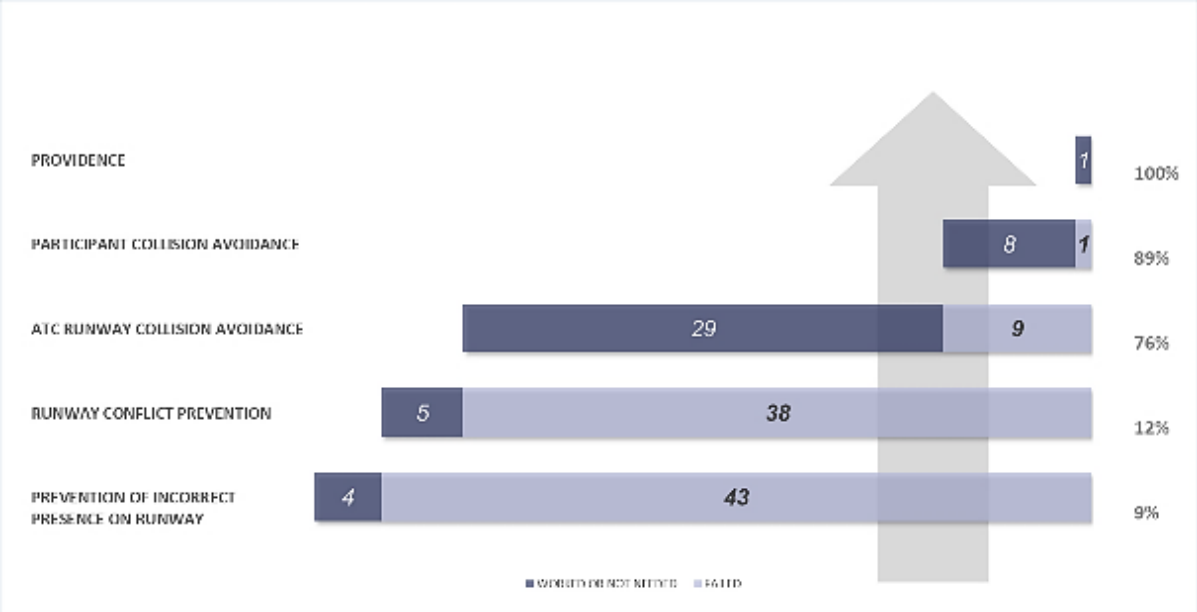

Figure 6-1: Overall barrier performance

- Performance of the basic barrier “Prevention of Incorrect Presence on Runway”: challenged 47 times, failed in 43 cases (91%) and worked in 4 cases (9% success). This high degree of failure is not a surprise, due to the high severity (A and B) of the events included in the analysed data sample.
- Performance of the basic barrier “Runway Conflict Prevention”: challenged 43 times, failed in 38 cases (88%) and worked or was not needed in 5 cases (12% success).
- Performance of the basic barrier “ATC Runway Collision Avoidance”: challenged 38 times, failed in 9 cases (24%) and worked or was not needed in 29 cases (76% success).
- Performance of the basic barrier “Conflict Participant Runway Collision Avoidance”: challenged 9 times, failed in 1 case (11%) and worked or was not needed in 8 cases (89% success).
- Performance of the basic barrier “Providence”: challenged once and worked or was not needed in that case (100% success).

6.2 Performance of first barrier "Prevention of Incorrect Presence on RWY"

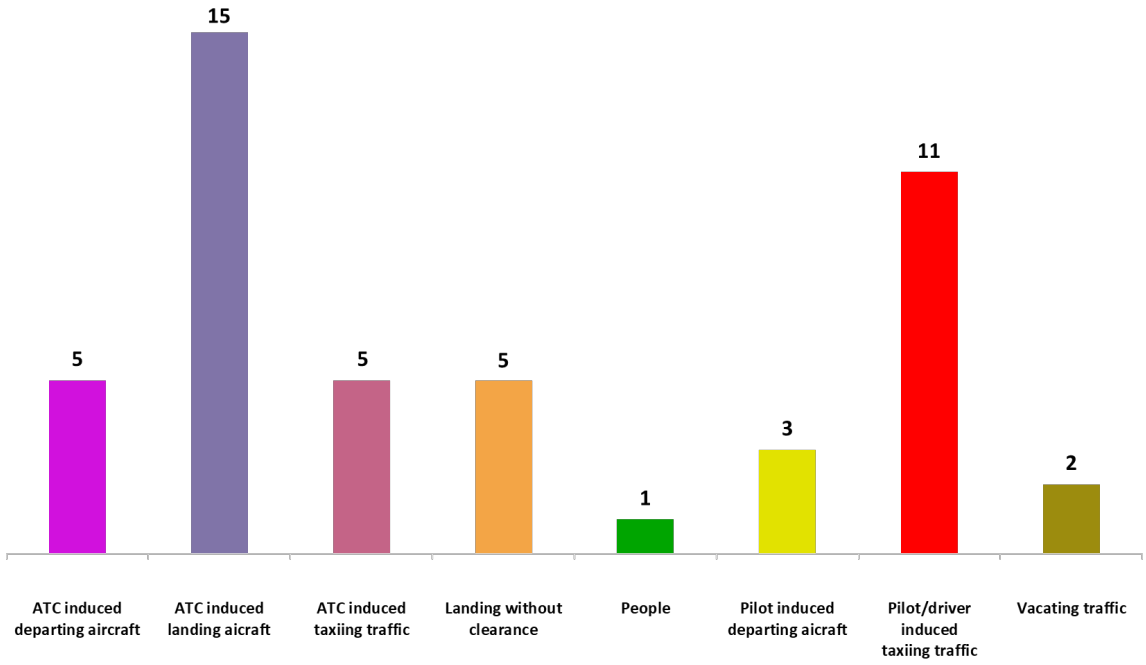

Figure 6-2: Runway incursion scenarios and initiators

The SAFMAP analysis helped identify the following initiating factors that played a role in the 2024 occurrence data sample:

- In 15 incidents (32% of the data sample) the runway incursion/separation infringement was caused by an "ATC induced incorrect presence of landing aircraft", retaining a similar share to the previous two years.
- In 11 incidents (23% of the data sample) the incorrect presence on the runway was caused by "Pilot/driver induced incorrect entry of taxiing traffic".
- In 5 incidents (11% of the data sample) the initiator was "ATC induced incorrect presence of departing aircraft".
- In 5 incidents (11%) the incorrect presence on the runway occurred due to "ATC induced incorrect entry of taxiing traffic".
- In 5 incidents (11%), the runway incursion was caused by "Aircraft landing without clearance".
- In 3 incidents (6%), the runway incursion was due to "Pilot induced incorrect presence of departing aircraft".
- In 2 incidents (4%), the incorrect presence on runway was caused by "Vacating traffic".
- In 1 incident (2%), the runway incursion was due to "Incorrect presence of a person".

The notable difference in the distribution of events by initiator to the 2023's sample, is that ATC induced departing aircraft and ATC induced taxiing traffic events have roughly halved in both numbers and shares, and landing without clearance incidents have doubled.

6.3 Barriers' resilience per initiator

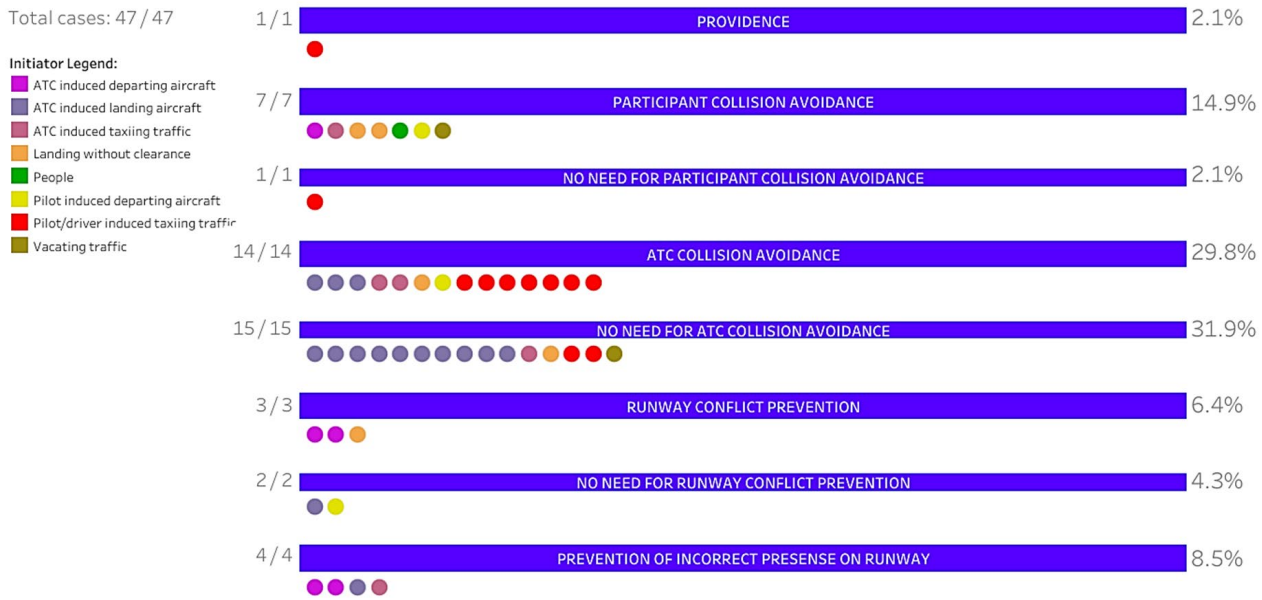

Figure 6-3: Barrier resilience per initiator

Figure 6-3 illustrates the distribution of incidents that were stopped by a barrier and those that crossed it, as well as the resilience of the barriers to the different initiators. The following can be concluded regarding the barrier effectiveness:

- 19% of the events crossed all ATC runway collision prevention barriers – an increase in barrier effectiveness and decrease in event criticality compared to the previous years (27% in 2023 and 44% in 2022).
- The "ATC runway collision avoidance" barrier stopped nearly 2/3^{rds} of the hazardous events (62% of all events, with "No need for ATC collision avoidance" at 32%), more effective than in 2023 (55% of all events). It is to be noted that half of those events were resolved without ATCO proactive intervention, i.e. were stopped by the 'technical barrier' – "No need for ATC collision avoidance".
- 17% of the conflicts were stopped by Participant collision avoidance – reducing from 22% in the previous year.
- 11% of events were stopped at the "Runway conflict prevention" barrier this year – a reduction from 18% the previous year.
- 8.5% of events were stopped at the first basic barrier – "Prevention of incorrect presence on runway" – compared to zero in 2023 and 7% in 2022.
- 1 event (2%) crossed all ATM barriers and was stopped at the "Providence" barrier (down from 3 events – 5% – in the previous two years).
- Half of the events (53%) in the 2024 data sample have been induced by ATC.
- There is not a single initiator that stands out as the single most safety-critical; rather, one or two events of each initiator (except for ATC induced landing aircraft) passed through the ATC barriers.
- Pilot/driver induced taxiing traffic events' distribution across the barriers suggests this initiator had a high safety criticality in 2024: none of these events were stopped at the lower tier barriers, they comprise half of all events that were stopped by ATC collision avoidance action and 22% of all events that reached the last two barriers, one of which was only stopped by 'Providence'.

- Similarly, landing without clearance events exhibit a relatively high safety criticality with 2/5^{ths} of the incidents stopped by a participant and another 2/5^{ths} stopped at the ATC collision avoidance barrier.
- ATC induced events (incorrect presence of departing aircraft, landing aircraft and taxiing traffic) have markedly lower safety criticality compared to previous years. For example, no event of ATC induced incorrect presence of landing aircraft passed the “ATC collision avoidance” barrier and 2/3^{rds} of those events did not require ATC collision avoidance action.
- Pilot induced departing aircraft incidents have a distribution and number of events consistent with the previous year.
- 1 event (of high criticality) involved incorrect presence of a person on the runway.

6.4 ATC induced landing aircraft events

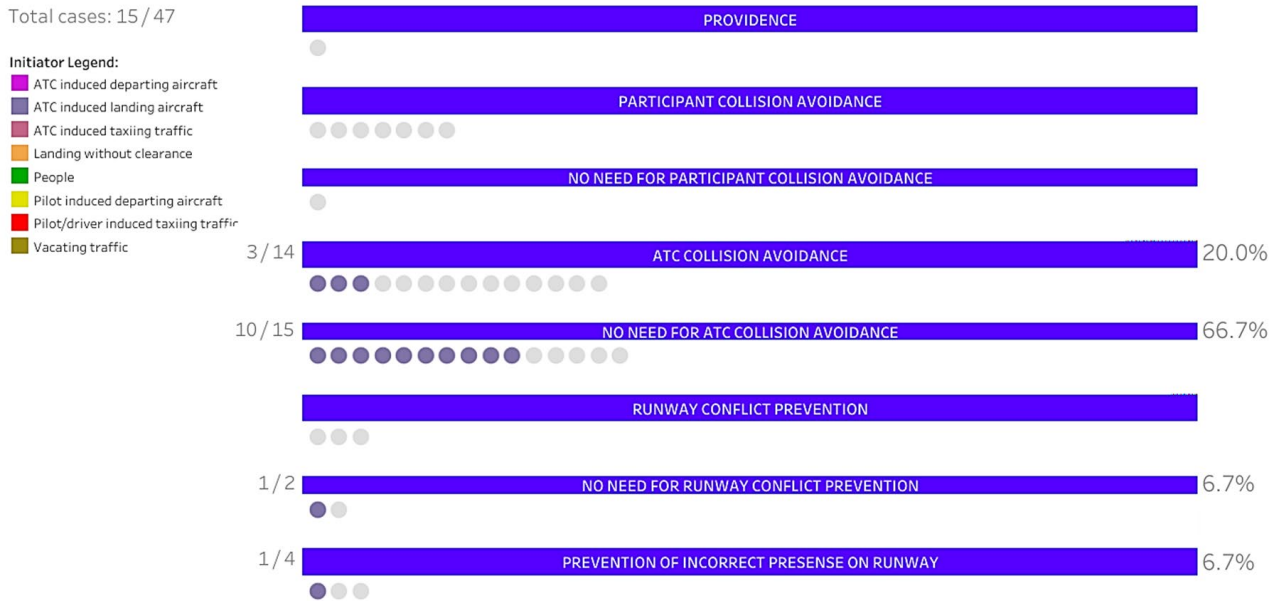

Figure 6-4: Incorrect presence of landing aircraft induced by ATC

Figure 6-4 provides insight into the causal factors of the incidents of "ATC induced incorrect presence of landing aircraft". The following was identified:

- This is the largest initiator in 2024's data sample accounting for 32% of the analysed data sample (15 events).
- There is a notable decrease in the safety criticality of ATC induced incorrect presence of landing aircraft incidents in 2024 as none crossed the ATC barriers (down from 25% in the previous year).
- Most (87%) of the events were stopped at the ATC collision avoidance barrier, with the majority of those (77%) not requiring ATC collision avoidance action.
- 53% were due to insufficient aircraft spacing and 47% were caused by incorrect or late ATC clearance.
- In 4 out of the 15 events (27%), ATC did not detect the conflict and issued landing clearance despite the correct presence of another aircraft/mobile on the runway.
- In 3 out of the 15 events (20%), non-commercial flights were involved.
- In 2 out of the 15 events (12.5%), ATC position handover was reported as a factor.
- 2 out of the 15 events (12.5%) occurred during high controller workload.

6.5 Pilot/driver induced taxiing traffic events

Figure 6-5: Incorrect RWY entry caused by pilot/driver

Figure 6-5 provides insight into the incidents of incorrect entry of taxiing traffic onto the runway protected area induced by pilot/driver. The following was identified:

- Pilot/driver induced incorrect entry of taxiing traffic is the 2nd largest initiator in 2024's event sample accounting for 23% of the analysed events (11 events).
- The events initiated by pilot/driver induced incorrect entry of taxiing traffic onto the runway are of relatively high criticality: 18% of them (2 events) passed all ATC collision avoidance barriers, accounting for 22% of the share of all high criticality events that did so, and the one event stopped only by Providence in the data sample.
- 81% of pilot/driver induced taxiing traffic incidents were stopped at the ATC collision avoidance barrier, with 22% of those not requiring any controller collision prevention action.
- 45% (5) of the events involved incorrect clearance execution, 27% (3) were due to position confusion, 18% (2) involved inadequate communication, and 9% (1) were due to not obtaining ATC clearance when needed.
- 6 out of the 11 incidents (55%) could have been prevented by stop bars.
- 5 out of the 11 incidents (45%) involved non-commercial flight.
- In 4 out of the 11 events (36%), ATC did not detect the potential runway conflict.
- In 3 out of the 11 events (27%), vehicles were involved.
- In 2 out of the 11 events (18%), a helicopter was involved.
- In 2 out of the 11 events (18%), ATC issued a landing clearance after incorrect presence on the runway.

6.6 Landing without clearance events

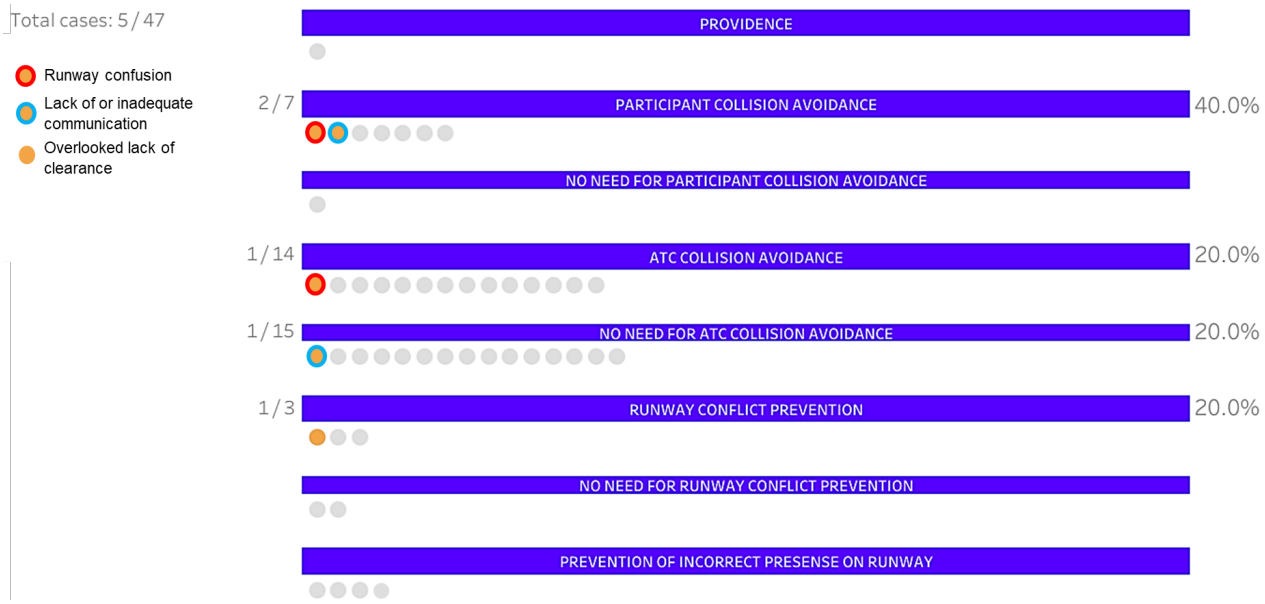

Figure 6-6: Aircraft landing without clearance

Figure 6-6 provides insight into the incidents of aircraft landing without clearance. The following was identified:

- Landing without clearance is a significant initiator in 2024's data sample accounting for 11% of the analysed incidents (5 events).
- This type of event appears to be of relatively high safety criticality, but the low number of events reported make it difficult to draw robust conclusions. Even so, the distribution of landing without clearance events across the barriers is consistent with previous years.
- 2 out of the 5 events (40%) passed through all ATC barriers and were stopped by a conflict participant taking collision avoidance action.
- 2 events (40%) were initiated by runway confusion, another 2 events (40%) by a lack of or inadequate communication, and a further 1 event (20%) by the pilot overlooking the lack of landing clearance.
- All events involved non-commercial flights.
- 2 out of the 5 events (40%) involved a helicopter.

6.7 ATC induced taxiing traffic events

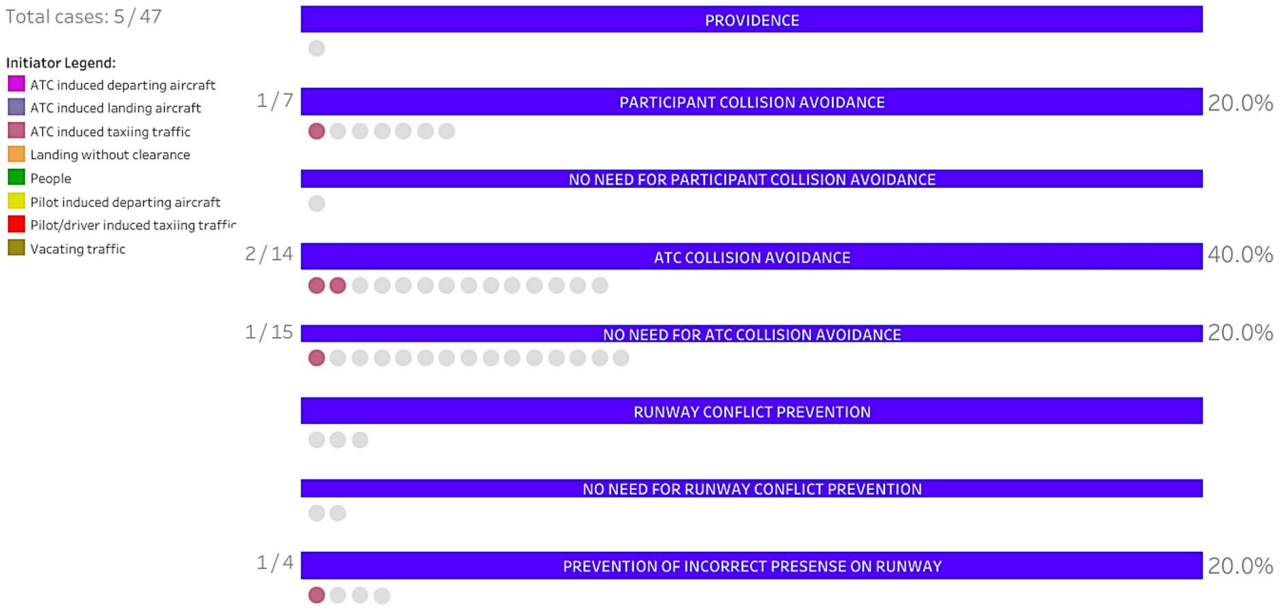

Figure 6-7: Incorrect presence of taxiing traffic induced by ATC

Figure 6-7 provides insight into the causal factors of the incidents of "ATC induced incorrect presence of taxiing traffic". The following was identified:

- ATC induced incorrect presence of taxiing traffic is a significant initiator in 2024's data sample accounting for 11% of the analysed incidents (5 events).
- 1 of the 5 events (20%) was of high criticality, requiring conflict participant collision avoidance.
- In 4 out of the 5 events (80%) the ATCO did not detect the conflict, and the remaining 1 event (20%) was caused by an incorrect ATCO plan.
- In 2 out of the 5 events (40%), both vehicles and non-commercial flights were involved.

6.8 ATC induced departing aircraft events

Figure 6-8: Incorrect presence of departing aircraft induced by ATC

Figure 6-8 provides insight into the causal factors of the incidents of "ATC induced incorrect presence of departing aircraft". The following was identified:

- ATC induced incorrect presence of departing aircraft is a significant initiator in 2024's data sample accounting for 11% of the analysed incidents (5 events).
- 1 event (20%) passed all ATC barriers, accounting for 11% of all events that reached the last two barriers.
- All events were due to ATC issuing conflicting clearances.
- In 3 out of the 5 events (60%) ATCO did not detect the potential runway conflict and issued take-off clearance after correct presence on the runway.
- In 2 out of the 5 cases (40%) the view from the Control Tower was constrained.

6.9 ATC not detecting the potential runway conflict

Figure 6-9: Non-detection of potential RWY conflict by ATC

Figure 6-9 showcases the events in which ATC did not detect the potential runway conflict. The following can be noted:

- The incidents in which ATC did not detect the potential runway conflict account for 38% (18 events) of the analysed sample.
- 22% of the events passed all ATC barriers, comprising 44% of all incidents that reached the last two barriers, exemplifying the high safety criticality of incidents in which ATC did not detect the potential runway conflict.
- “ATC induced taxiing traffic”, “ATC induced landing aircraft” and “Pilot/driver induced taxiing traffic” initiators have equal shares – 22% of events each – followed by “ATC induced departing aircraft” (17% of events).
- In 17% of the events ATC gave take-off clearance after correct presence on the runway. (These are the events of ATC induced incorrect presence of departing aircraft.)
- In 22% of the events ATC gave landing clearance after correct presence on the runway. (These are the events of ATC induced incorrect presence of landing aircraft.)
- In 22% ATC gave landing clearance after incorrect presence on runway.
- In 11% ATC gave take-off clearance after incorrect presence on the runway.
- 39% of the incidents involved non-commercial flights.
- 28% involved vehicles.
- In 28% of the events SMGCS was unavailable.
- 17% of the events could have been prevented by stop bars.
- In 17% of the events the view from the Control Tower was constrained.
- 11% (2 out of the 18 events) involved incorrect use of runway occupancy memory aids by the ATCO.

Due to the significant share and high safety criticality of the events associated with ATC not detecting the runway conflict, it is suggested to keep “Controller detection of the potential runway conflict” as a safety priority in 2024.

6.10 Contextual factor analysis – incorrect presence on runway

This section presents the results of the analysis of the significant contextual factors reported in the description of the occurrences of incorrect presence on the runway included in the 2024 event sample. The contextual factors selected for their significance in the sample include: non-commercial flight involved, stop bars being able to prevent the conflict, vehicle participation, and high controller workload.

6.10.1 Non-commercial flight involved

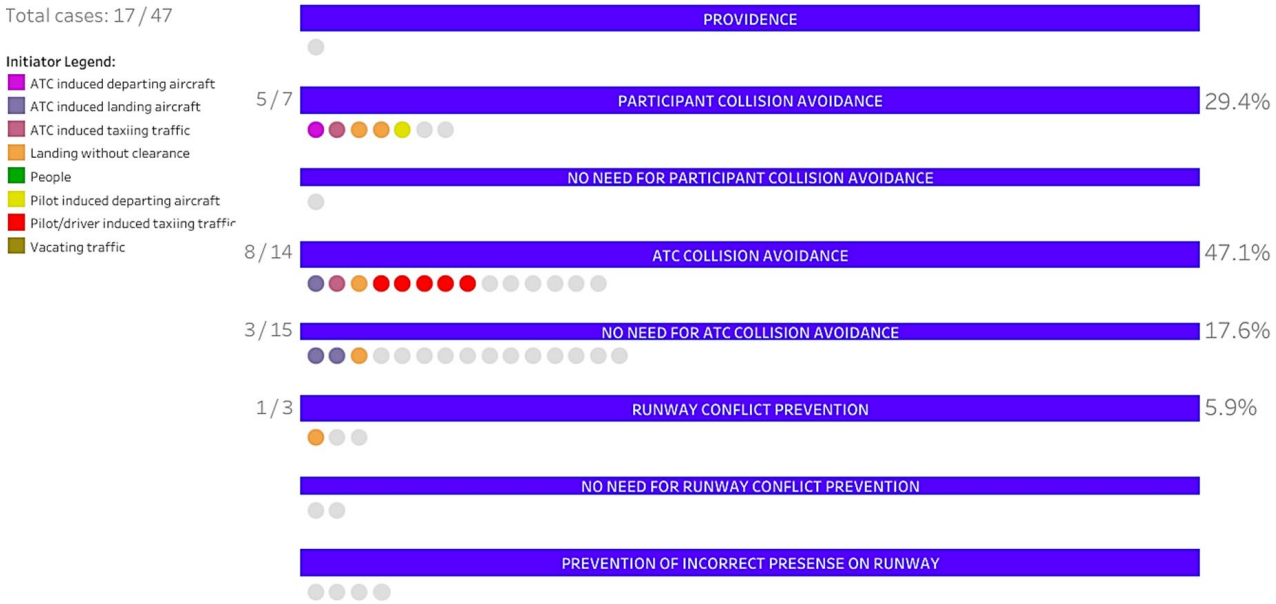

Figure 6-10: Non-commercial flight involved

Figure 6-10 illustrates the incidents associated with reported non-commercial flight involvement. The following can be noted:

- The incidents which involved non-commercial flight account for 36% of 2024's event sample (same as in the previous two years).
- 29% (5 out of 17) of the events reached the last two barriers, decreasing from 37% in 2023 and 54% in 2022.
- Incidents involving non-commercial flights constitute roughly half of all events in the sample that passed all ATC barriers (similar to the previous year's sample). Non-commercial flight events retain their high criticality status.
- "Landing without clearance" is the most safety critical initiator in this group, with a 29% share among the various initiators and 40% share (2 out of 5) of events involving non-commercial flight, which crossed all ATC barriers.
- It can be noted that all events of "Pilot/driver induced incorrect entry of taxiing traffic" were stopped by ATC collision avoidance.
- The main difference to 2023 is the increase in share and safety criticality of "Landing without clearance" events and the decrease of the safety criticality of "ATC induced incorrect presence of landing aircraft" events.
- In 41% of the events, ATC did not detect the potential runway conflict when issuing clearance.
- 24% were preventable by stop bars.
- In 24%, a helicopter was involved.

- 18% also involved vehicles.

It is therefore suggested to continue monitoring the safety risk associated with events involving incorrect presence of non-commercial flight aircraft on the runway protected area.

6.10.2 Conflicts that could have been prevented by stop bars

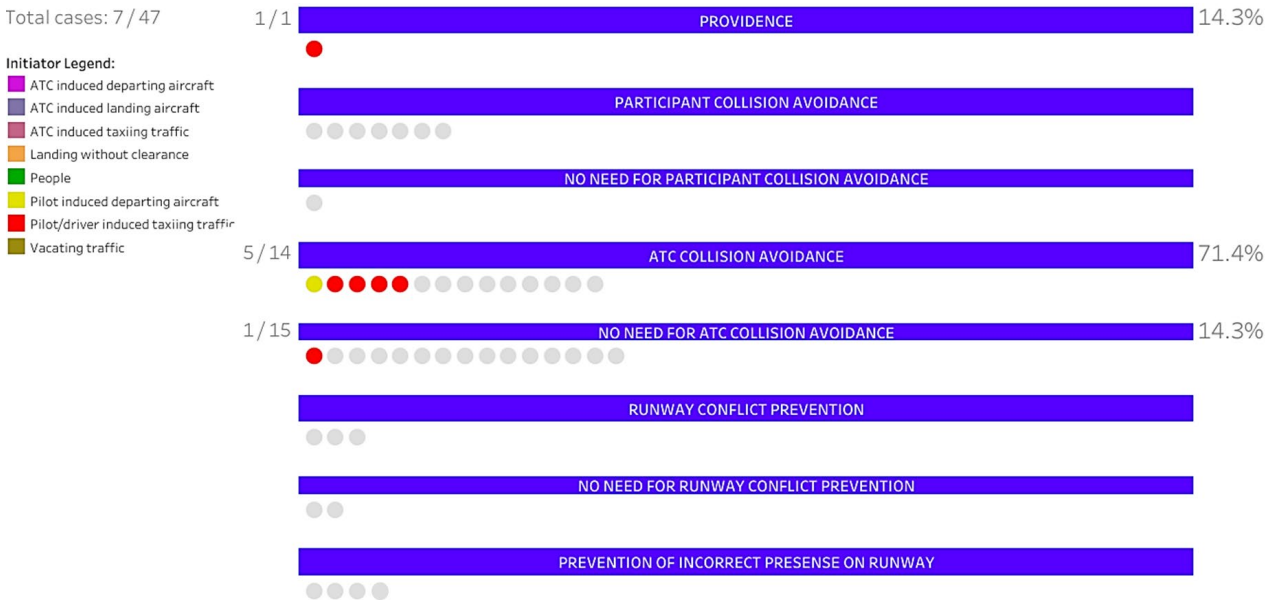

Figure 6-11: Incidents preventable by stop bars

Figure 6-11 showcases the incidents which could have been prevented by stop bars. The following can be noted:

- 15% (7) of all events in the 2024 sample could have been prevented by stop bars if installed at all runway holding positions and used 24 hours a day.
- All but one event (86%) were initiated by “Pilot/driver induced incorrect entry of taxiing traffic”.
- It should be noted that the only event reaching the ‘Providence’ barrier in this year’s sample could have been prevented by stop bars.
- 4 out of the 7 events (57%) involved non-commercial flights.
- In 3 out of the 7 events (43%), ATC did not detect the runway conflict before issuing clearance.
- 2 out of the 7 events (29%) involved a helicopter.

Considering the risk mitigation potential of 24/7 stop bars use at runway holding positions, it is suggested that this factor is noted in the report.

6.10.3 Events with vehicle participation

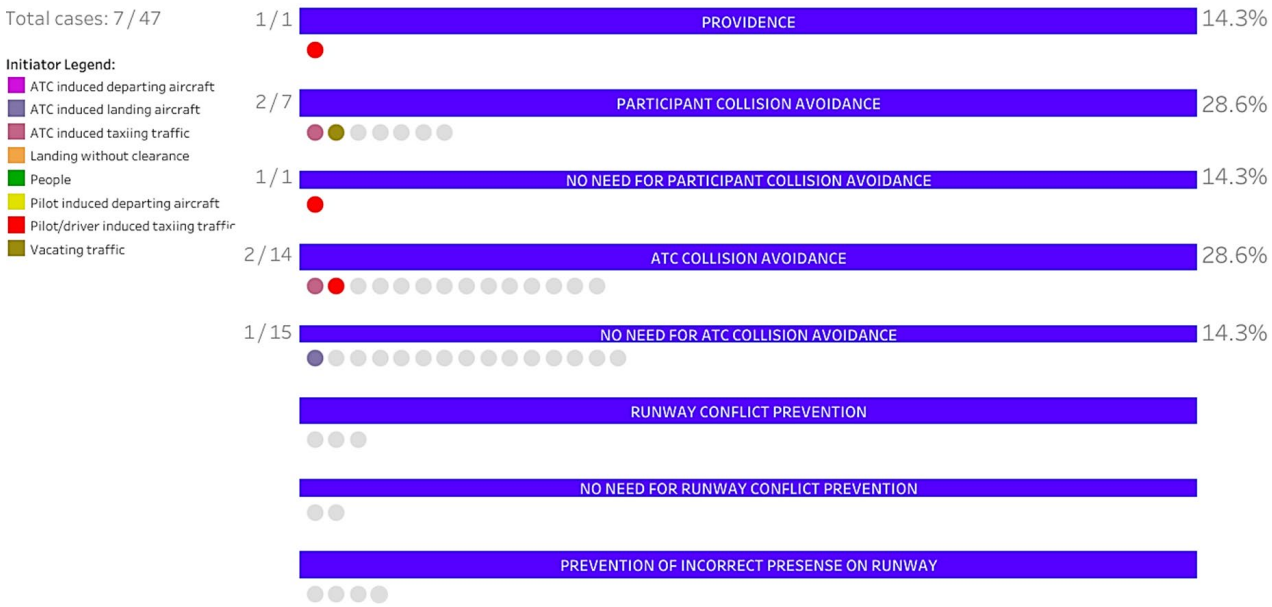

Figure 6-12: Incidents involving vehicles

Figure 6-12 illustrates the incidents associated with reported vehicle involvement. The following can be noted:

- Events involving vehicles make up 15% of the analysed sample.
- A shift toward higher safety criticality is observed since the previous year. Just over half of the events passed through the “ATC collision avoidance” barrier in 2024 (57%) whereas only one events did so in 2023 (14%). Events with vehicle involvement account for 44% of high safety criticality events in the data sample that reached the last two barriers.
- In 5 out of the 7 events (71%), ATC did not detect the potential runway conflict before issuing clearance.
- In 3 out of the 7 events (43%), non-commercial flights were involved.
- 2 out of 7 events (29%) occurred during work-in-progress.

Considering the safety criticality of the events involving incorrect presence of vehicles, it is suggested to monitor the risk associated with it.

6.10.4 Events involving high ATC workload

Figure 6-13: Incidents involving high controller workload

Figure 6-13 illustrates the incidents associated with reported high ATC workload. The following can be noted:

- Events associated with high controller workload account for 6% of the analysed sample (3 events).
- 1 out of the 3 events was stopped by conflict participant collision avoidance – the event was initiated by landing without clearance and the conflict was not detected by ATCO.
- 2 out of the 3 events were caused by ATC induced incorrect presence of landing aircraft and were stopped at the technical barrier “No need for ATC collision avoidance”.
- 2 events involved non-commercial transport flight.
- 1 event involved vehicle.
- 1 event occurred after controller position HOTO.

==End of document==

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