EUROCONTROL

CONTROLLER DETECTION OF POTENTIAL RUNWAY CONFLICT

EUROCONTROL Network Manager Top 5 Operational Safety Review

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TABLE OF CONTENT

TABLE OF FIGURES

1 Definition

(1) **Controller detection of potential runway conflicts and why should we be concerned about it**

(2) In air traffic control, controller detection of potential conflicts, particularly regarding runways, is a fundamental necessity to ensure a safe operation. When controller detection issues arise, a critical barrier is compromised, and the continuing safety of the operation is jeopardised. Controller detection is primarily a human performance issue. Specifically, issues with controller detection of potential runway conflicts are typically characterised by the controller not detecting a conflict with authorised, or unauthorised, aircraft, vehicles or personnel when clearing or instructing another aircraft. Given that aircraft, vehicles, and personnel in an airport environment are in close proximity, a failure of this critical barrier many times results in an incident. There are a variety of scenarios that can lead to this negative consequence. There are also a variety of barriers that may be introduced, and if used properly, assist in preventing incidents, or mitigating their outcomes.

(3) Controller detection of potential runway conflicts has been a EUROCONTROL Network Manager Top 5 operational safety priority dating back to 2013. Recent Safety Functions Map (SAFMAP) barrier analysis, encompassing data from 2013-2021, shows that during this 9-year period, 41% of all analysed A and B runway incursion incidents at European airports could have been prevented by controller detection of potential runway conflicts.

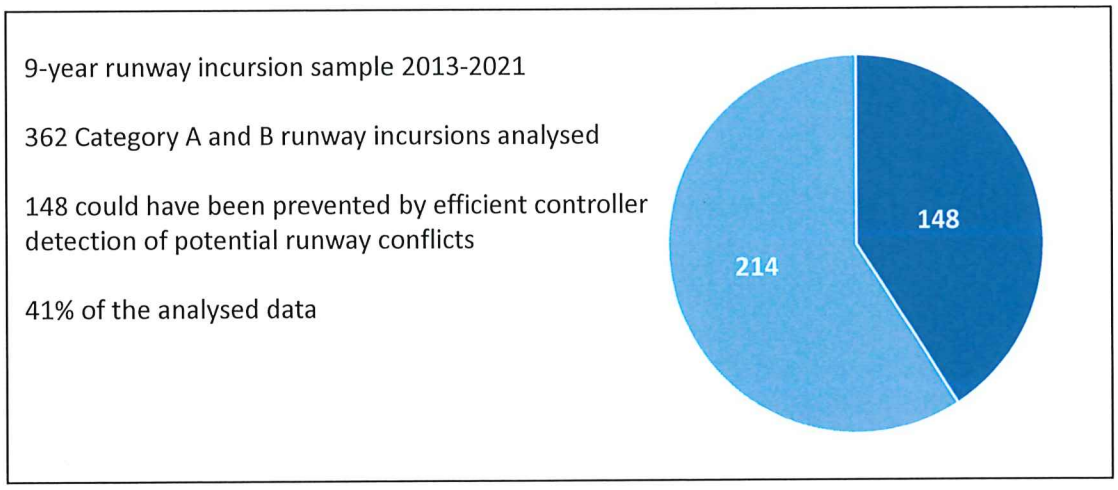

Figure 1 Controller Detection of Potential Runway Conflict Incidents 2013-2022

(4) This is a significant percentage. This suggests all ANSPs would be well served by evaluating the incidence and risk of controller detection of potential runway conflict events in their area of responsibility. (Note: 2020 is considered an anomalous year due to the significant operational impacts of the COVID-19 pandemic).

2 Understanding Controller Detection of Potential Runway Conflict

(1) Since controller detection of potential runway conflict incidents are, by definition, a human performance issue, we will never be able to eliminate them entirely. However, there are several contributing factors that are frequently present in controller detection incidents. These will be covered in more detail later in this paper. If these factors are addressed, it is possible to strengthen the controller detection barrier.

(2) While we may not be able to prevent all controller detection incidents, we can manage the risk associated with them. With proper understanding of the risk of such incidents in the respective operation, and the barriers that can affect a controller's attention and ability to recognise such conflicts and act to resolve them, it is possible to reduce the frequency of controller detection incidents and the severity of such events when they do happen.

(3) To put it another way, an ATS provider will not be able to eliminate them but can manage them.

(4) To do this, there is a need to understand the human performance factors at play and the barriers that can be put in place to provide controllers with safety nets, tools, and strategies to reduce the likelihood, or severity, of such incidents.

3 Our Approach

(1) There are several operational scenarios that are prevalent when examining past incident data involving controller detection of potential runway conflict. While we will discuss those in depth later, evaluating these will help understand when and where controller detection events may happen. This also points to where we should strengthen barriers, introduce decision support tools and what manner of strategies can assist controllers with reducing detection of potential runway conflict incidents.

(2) Ideally, we could prevent the triggers that result in these scenarios developing. However, this is not always operationally feasible. It is unrealistic to believe that we could prevent every possible scenario by preventing its trigger from occurring. The system is simply too complex for that. Complete prevention is not a realistic approach, but reduction is. If we can reduce the likelihood of the triggers occurring in these scenarios, we should be able to successfully reduce the number of incidents involving controller detection of runway conflicts.

(3) Every incident also has contributing/contextual factors, although these are not necessarily specific to controller detection but instead are systemic factors across many incident scenarios. Preventing any of the other contributing/contextual factors, even if possible, would not reliably prevent all detection incidents, but could potentially reduce the chance of them happening.

(4) Once we understand the scenarios, contributing and contextual factors around controller detection issues we can then begin to put in place and strengthen effective barriers.

4 Operational Scenarios

(1) Annually, EUROCONTROL Network Manager conducts a series of dedicated workshops with multiple ANSPs, serving a large part of European air traffic (the Network Manager Top 5 process). Comprehensive barrier models – Safety Functions Maps (SAFMAPs) - are populated with data from the participating ANSPs and analysed. The incident data is comprised of high severity (classified as 'A' and 'B') events, which are both thoroughly investigated and highly informative because the incident scenarios 'tested' the majority of the available safety barriers. In the next sections, we present information based on the EUROCONTROL Network Manager SAFMAP data.

(2) Analysis has identified four general operational scenarios (triggers), each with different variations, that are prevalent when controller detection incidents occur. While there may be others in any specific ANSP or operation, addressing these four, if mitigated appropriately, may lead to a significant reduction in controller detection incidents.

(3) Many of these scenarios may involve memory/focus/attention issues, communication issues, mental confusion, or fatigue. The scenarios are as follows:

Scenario 1: Runway conflict could have been prevented by ATC potential conflict detection before clearing taxiing traffic or person to enter RWY

(4) One variation of this scenario occurs when a controller has forgotten about, and does not detect, a current or planned authorised landing or departing aircraft on an active runway. This scenario may involve not using existing memory aids, or inefficient memory aids being used. It may also be an issue during handover and the clearance not being passed. The controller does not execute a structured scan for potential conflicts and clears another aircraft, vehicle, or pedestrian to enter the active runway. The clearance leads to a conflict with the arriving or departing aircraft.

(5) Below is an example of this type of scenario:

A B737 landed on Runway 31L. The Local Controller instructed the B737 to exit at Taxiway H and hold short of runway 31R. The pilot read back was correct.

A BE20 was cleared to land on runway 31R.

As the BE20 was touching down on runway 31R the Ground Controller instructed the B737 to cross Runway 31R at Taxiway H. The Ground Controller recognised the error and immediately instructed the BE20 to go-around and instructed the B737 to hold position.

The B737 crossed the runway stop bars but came to a stop prior to the Runway 31R edge line. The BE20 complied as instructed, resulting in a touch and go on runway 31R

(6) Another variation of this scenario occurs when a controller does not detect a current or imminent unauthorised landing or departing aircraft on an active runway. The controller does not execute a structured scan for potential conflicts and clears another aircraft, vehicle, or pedestrian to enter the active runway. The clearance leads to a conflict with the arriving or departing aircraft.

(7) Below is an example of this type of scenario:

A C172 was instructed to taxi to, and hold short of, Runway 23L. The Local Controller asked if the C172 was ready for departure, but the aircraft did not respond.

A PA28 entered the CTR airspace without authorization and was aligned on final for Runway 23L. The PA28 was not in communication with ATC.

The C172 established contact and advised Local Control they were ready for departure and the ATCO instructed them to line up and wait on Runway 23L when the PA28 was on an approximately 2 mile final.

Another ATCO observed the PA28 on final approach and alerted Local Control.

Local Control instructed the C172 to immediately exit the runway and attempted, unsuccessfully, to contact the PA28.

The PA28 landed without clearance and exited the runway.

Scenario 2: Runway conflict could have been prevented by ATC potential conflict detection before clearing an aircraft to land or to take-off

(8) One variation of this scenario occurs when a controller has forgotten about, and does not detect, current or planned authorised traffic on an active runway. This may include aircraft or vehicles: stationary, crossing, taxiing, landing or taking-off or the presence of people. This may involve not using, or using inefficient, memory aids. It may also be an issue during handover. The controller does not execute a structured scan for potential conflicts and clears another aircraft to land or depart the active runway. The clearance leads to a conflict with the previously authorised traffic.

(9) Below is an example of this type of scenario:

Local Control authorised an airport operations vehicle to enter Runway 08 from Taxiway B for a runway inspection.

Several minutes later Local Control cleared a PA31 for take-off on Runway 08, having forgotten about the airport operations vehicle.

The vehicle was monitoring Local Control frequency and, upon hearing the take-off clearance, advised Local Control they would exit the runway. The controller realised their mistake and instructed the vehicle to expedite.

The vehicle exited the runway at Taxiway C. The closest proximity between aircraft and vehicle was approximately 1500 feet.

(10) Another variation of this scenario occurs when a controller does not detect current or imminent unauthorised traffic entering (crossing, taxiing, landing or taking-off) or present (stationary aircraft/vehicle or people) on an active runway. The controller does not execute a structured scan for potential conflicts and clears another aircraft to land or depart the active runway. The clearance leads to a conflict between the arriving or departing aircraft and the unauthorised traffic.

(11) Below is an example of this type of scenario:

An SR22 advised Local Control they were on taxiway A at Runway 21 ready for departure.

Local control instructed the SR22 to hold short of Runway 21. The pilot read back was correct.

Local control cleared a C172 to land Runway 21.

An unknown aircraft announced that there was an SR22 on the runway.

Local control instructed the C172 on a .5 mile final to go around.

Local control then verified the aircraft on Runway 21 was the SR22 that had been instructed to hold short and instructed the aircraft to immediately exit the runway.

Scenario 3: Runway conflict could have been prevented by ATC recognising potential conflict between 2 aircraft landing/departing intersecting runways

(12) One variation of this scenario occurs when a controller has forgotten about, and does not detect, a current or planned authorised landing or departing aircraft on an active runway that intersects another active runway. In some cases, the same controller is responsible for both runways. The controller does not execute a structured scan for potential conflicts and clears another aircraft to land or depart the intersecting runway. In other cases, there are 2 controllers working the runways and coordination is required to sequence aircraft through the intersection. The controller does not coordinate for the intersection sequence and clears an aircraft to land or depart the intersecting runway. In both cases, the clearance leads to a conflict with another arriving or departing aircraft.

(13) Below is an example of this type of scenario:

Local control cleared a C177 for take-off from Runway 26R. Approximately 60 seconds later Local Control cleared a B737 for take-off from Runway 30, an intersecting runway, at Taxiway L3.

On departure roll, approximately 1,000ft down Runway 26R, the C177 heard and expressed concern reference the departure clearance on Runway 30 for the B737 and began to decelerate.

Local Control cancelled the departure clearance for the C177 and instructed the pilot to exit Runway 26R at Taxiway K2. The B737 continued down Runway 30 and departed.

(14) Another variation of this scenario occurs when a controller does not detect, a current or imminent unauthorised landing or departing aircraft on an active runway that intersects another active runway. The controller does not execute a structured scan for potential conflicts and clears another aircraft to land or depart the intersecting runway. The clearance leads to a conflict with the unauthorised arriving or departing aircraft.

(15) Below is an example of this type of scenario:

A CRJ2 was instructed to Line Up and Wait on Runway 01. A CRJ7 was issued departure instructions and instructed to Line Up and Wait on Runway 04, an intersecting runway.

The CRJ2 was then issued take-off clearance for Runway 01. Both aircraft simultaneously acknowledged the transmission, but it was not detected by ATC.

As the CRJ2 was approximately 1,000 feet into the take-off roll for Runway 01, the CRJ7 began their take-off roll on Runway 04.

As the CRJ2 crossed the runway intersection, the CRJ7 was 850ft from the same of Runway 04 and Runway 01 and traveling at 66knts.

The CRJ7 successfully aborted take-off on seeing the CRJ2.

Scenario 4: Runway conflict could have been prevented by ATC recognising potential conflict from aircraft entering/landing/departing a closed runway

(16) One variation of this scenario occurs when a controller has forgotten about and does not detect issuing a clearance authorising an aircraft to enter, land or depart a closed runway.

(17) Below is an example of this type of scenario:

At approximately 0800Z airport operations closed Runway 13/31 and Runway 5/23 for snow removal. ATC acknowledged.

At 0903Z airport operations opened Runway 13/31. ATC acknowledged but assumed, incorrectly, that Runway 5/23 was also opened.

At 0921Z, a CRJ2 was issued take-off clearance on Runway 23 by local control.

Airport operations was monitoring the frequency and alerted ATC to the runway still being closed.

(18) Another variation of this scenario occurs when a controller does not detect current or imminent unauthorised traffic entering (crossing, taxiing, landing or taking-off) on a closed runway.

(19) Below is an example of this type of scenario:

An A319 was on a visual approach to Runway 18R and established communications with Local Control on a right base.

Local Control issued landing clearance to the A319 for Runway 18R. The pilot read back was correct.

The A319 flew through the final for Runway 18R. Local Control asked if they were correcting back to the final and the pilot confirmed that they were. The A319 incorrectly aligned with Runway 18L which was closed for inspection.

The airport operations vehicle observed the incorrectly aligned A319 and alerted Local Control. Local Control instructed the A319 to go-around and received no reply. The A319 responded on the 3rd communications attempt and executed a go-around as they were crossing the runway threshold.

5 ATC Barriers

(1) As with most safety issues in complex air traffic control systems, there is no single barrier that can efficiently and universally prevent all the scenarios of controller detection incidents. Analysis has shown that a combination of strategies, practices, tools, and safety nets seems to deliver the most reliable protection to reduce the frequency and severity of incidents due to controller detection.

- Prevention barriers, when deployed and employed correctly, are capable of alerting ATC in time to prevent runway incursions, ground conflicts or alerting ATC before standard levels of safety are compromised. Many barriers were examined during the analysis to identify possible ways to reduce incidents due to controller detection or mitigate the consequences. Not all barriers are relevant to all situations and their adoption as a group may not necessarily be appropriate, or feasible. It may also be possible to identify more potentially useful barriers than are included here.
- Mitigation barriers, when deployed and employed correctly, are capable of alerting ATC to a runway incursion or a ground safety event in sufficient time for ATC to act in order to prevent a ground collision. When analysing controller detection incidents, a variety of mitigating barriers exist. Depending on the stage of the conflict, many of the barriers below may be either prevention or mitigation barriers. They give the controller a chance of a last-minute conflict resolution.

Barriers to help detect and mitigate ATC forgetting (omitting) about present/planned authorised traffic on the RWY (e.g., due to memory, communication, or mental confusion, etc.)

Routine structured scan

(2) Used to enhance the controller's situational awareness and remind of issued clearances. Examples of these are:

- Buttons or switches used by the controller when a clearance affecting the manoeuvring area is issued.
- Flight strip arrangement rules (e.g., if a take-off/landing clearance is issued to an aircraft, its flight strip is put into a red holder)
- Colour coding or obscuring on electronic displays of important information used in runway clearances.

(3) Memory Aids may be used in multiple specific ways, some examples include:

- Memory aids for current or planned authorised runway landing.
- Memory aids for current or planned authorised take-off.
- Memory aids for authorised simultaneous crossing runway operations.
- Memory aids for authorised traffic/person/obstacles on the runway (e.g., on the runway, crossing or to vacate).
- Memory aids for closed RWY.

Systematic processes and ATC communication procedures

(4) Such processes and procedures may help reduce possibility of omission and avoid misunderstandings about clearances given or RWY status. They are useful in many situations including:

- ATC coordination (e.g., Ground and Tower).
- Hand-over / take-over of operating position Operational Team Resource Management.

Procedures to increase situational awareness when vehicles occupy a runway

(5) (e.g., Vehicle 'Operations Normal' calls to ATC).

Operational Team Resource Management (TRM) – colleague warning

A procedure stating that all vehicles entering a runway should broadcast "runway entry" notification

Barriers to help ATC detect and mitigate actual presence of traffic/person/obstacle (authorised or unauthorised) on the RWY before giving another clearance for the RWY

ATCO direct visual detection

(6) One of the main responsibilities of a tower controller is to constantly observe the situation on the manoeuvring area and verify that all clearances are properly complied with.

Operational Team Resource Management (TRM) – colleague warning

Staffing of coordinator positions

(7) ATC positions such as Cab Coordinator, Crossing Coordinator or Local Assist increase situational awareness within the tower cab by allowing for another ATCO to focus on coordination of aircraft in the manoeuvring area and on active runways.

ATCO detection and/or resolution following report from involved aircraft/vehicles or third party (monitoring frequency)

(8) This barrier relies on voluntary information from another person. While usually this cannot be legally described and written down as a procedure, experience shows that this barrier turns out to be one of the most effective tools.

Detection using remote camera displays

(9) These are used when parts of the manoeuvring area cannot be observed, or are too distant for reliable observation, from the control tower (e.g. due to obstacles, airport layout, etc.). They supplement the direct visual detection. In addition to simple visual display, cameras may have enhanced capabilities such as motion detection, target tracking, infrared capabilities, etc.

ATCO detection (e.g., of occupied runway) by use of basic Surface Movement Radar (SMR)

(10) This tool provides surveillance information in poor visibility conditions when the effectiveness of direct visual detection and remote cameras are degraded. It also helps controllers to identify smaller objects (vehicles or aircraft) which are at relatively long distance from the control tower. A potential disadvantage is that normally there are no visual or aural warnings and therefore the controllers need to divert their attention from visual observation to use the SMR.

Advanced Surface Movement & Guidance Control System (A-SMGCS) level 1 providing identification of both aircraft and transponder-equipped vehicles

(11) This tool is an enhanced version of the SMR. It provides identification of both aircraft and transponder-equipped vehicles. The tool relies on the proper use of transponders. When configured and used correctly, A-SMGCS provides reliable information on the traffic situation both on the manoeuvring area and the immediate airport vicinity.

A-SMGCS level 2 providing conflict alerts in addition to A-SMGCS level 1 data

(12) This tool is an enhancement of the A-SMGCS Level 1. It provides conflict alerts in addition to aircraft/vehicle identification. The logic is similar to STCA used in area control. While this feature is a great enhancement compared to A-SMGCS Level 1 it only warns the controller of immediate risks and does not take into account the issued clearances (which might be conflicting).

A procedure stating that all vehicles entering a runway should display high visibility flashing/strobing lights on in all visibility conditions

(13) Following such a procedure enhances the situational awareness of all participants (controllers, pilots, vehicle drivers and other people on the manoeuvring area) as it gives them information about the flight crew intentions. This also improves the effectiveness of the "ATCO resolution following pilot/driver report" barrier.

A procedure stating that all vehicles entering a runway should broadcast "runway entry" notification

ATCO detection after alert from airport ground systems that detect entry onto the runway (e.g., magnetic loops or lasers).

Barriers to help ATC detect and mitigate imminent presence of traffic/person (authorised or unauthorised) based on predicted trajectory, position, and speed, relative to RWY protected area

ATCO direct visual detection

Operational Team Resource Management (TRM) – colleague warning

Staffing of coordinator positions

Detection using remote camera displays

ATCO detection (e.g., of occupied runway) by use of basic Surface Movement Radar (SMR)

Advanced Surface Movement & Guidance Control System (A-SMGCS) level 1 providing identification of both aircraft and transponder-equipped vehicles

A-SMGCS level 2 providing conflict alerts in addition to A-SMGCS level 1 data

A procedure stating that all vehicles entering a runway should display high visibility flashing/strobing lights on in all visibility conditions

Barriers to help detect and mitigate ATC conflicting clearances

ATCO direct visual conflict detection

Operational Team Resource Management (TRM) – colleague warning

Staffing of coordinator positions

ATCO detection and/or resolution following report from involved aircraft/vehicles or third party (monitoring frequency)

Integrated Tower Working Position (ITWP) display of both traffic situation and controller input (ATC clearances), and alerting

(14) This is an ATC system that displays both traffic situation and controller input (ATC clearances) which enables the use of "early warning" features that:

- ❑ Highlight any non-conformance to clearance.
- ❑ Highlight the potential consequences of any incorrect clearance.

Use of discrete names for holding positions and pilot reports e.g. reporting point REKRA instead of P2

(15) This barrier helps reduce the chance of mishearing or misunderstanding a clearance.

Runway Status Lights (RWSL)

(16) A RWSL system derives traffic information from surface and approach surveillance systems and illuminates red in-pavement airport lights to signal a potentially unsafe situation. Runway Entrance Lights are deployed at taxiway/runway crossings and illuminate if it is unsafe to enter or cross a runway. Takeoff Hold Lights are deployed in the runway by the departure hold zone and illuminate red when there is an aircraft in position for departure and the runway is occupied by another aircraft or vehicle and is unsafe for takeoff.

6 Best Practices

(1) There are many best practices that have been identified that can support functional barriers such as those listed above. When implemented properly, best practices can provide ATC and Pilots/Ground Operations with enhanced situational awareness and potentially reduce the frequency, or the severity, of negative outcomes. Below is a non-exhaustive list of best practices that may pertain to the situations discussed in this paper:

Communications

- ❑ Conflict participants should be under the control of a single ATCO.
- ❑ Conflict participants should be on the same frequency.
- ❑ Conflict participants should both be controlled in English.

Coordination (ATC)

- ❑ Following runway closure, do not allow any runway movement until clear "Runway available for use" message has been received.
- ❑ Establish procedures for ownership of runway for respective ATC Tower working positions.
- ❑ Use explicit clearance for any runway crossing.

ATC Operations

- ❑ Do not issue line up clearance if aircraft will be on the runway longer than 90 seconds.
- ❑ Segregate arrival and departure operations (if possible).

Vehicle Operations

- ❑ Require mandatory transponder/Mode S squitter usage for airside operations.
- ❑ Vehicles should be of a colour that is clearly distinguishable against background environment.
- ❑ Vehicles entering runway should always proceed in opposite direction of landing/departing aircraft.
- ❑ Vehicles should park opposite direction of landing/departing aircraft and turn lights on .
- ❑ Vehicles should transmit "On runway" reminders at regular intervals.
- ❑ After runway works, do not allow any runway movement until clear message has been received about vehicles vacating runway.
- ❑ Vehicles' personnel should not leave the relevant radio unmonitored.
- ❑ Airside vehicles should have unique callsigns.

Airport Environment

- ❑ Use enhanced runway signage in case of runway closure or work in progress.
- ❑ Do not allow work on active runway if outside ATC visual range (direct/remote).
- ❑ Restrict use of oblique or angled taxiways that limit flight crew visibility of threshold or final approach.
- ❑ Reduce runway crossing and vehicle runway occupancy by design.

7 Contributing Factors

(1) There are several contributing/contextual factors that have been identified in controller detection incidents. Addressing these factors may help reduce the frequency and/or severity of such events. The following is a non-exhaustive list of possible contributing factors:

- ❑ Memory – forgot to monitor or forgot previous action.
- ❑ Perception – not seeing aircraft/vehicle/pedestrian or conflict.
- ❑ Distraction – focus of attention elsewhere.
- ❑ Controller workload issues – high workload or under-load.
- ❑ Controller fatigue.
- ❑ Recent hand-over impacting the quality of the mental 'traffic picture'.
- ❑ Production pressure.
- ❑ Training in progress.
- ❑ Lack of coordination when needed.

8 What Does Data Say?

(1) The EUROCONTROL Network Manager, as part of its Top 5 safety prioritisation process, performed a SAFMAP risk and resilience analysis on the following sample:

- 9-year sample (2013 2021).
- The analysed 9-year sample includes 362 severity A or B runway incursion incidents, collected during dedicated sessions with ANSP representatives.
- The data sample includes 148 incidents of severity A or B where controller detection of potential runway conflicts could have prevented the incident.
- The sample is representative (by size and geographical coverage) for European operations.
- The sample is representative for information about risk scenarios, contributory factors, and resilience potential.

(2) The SAFMAP barrier resilience of the overall studied sample of incidents is presented below:

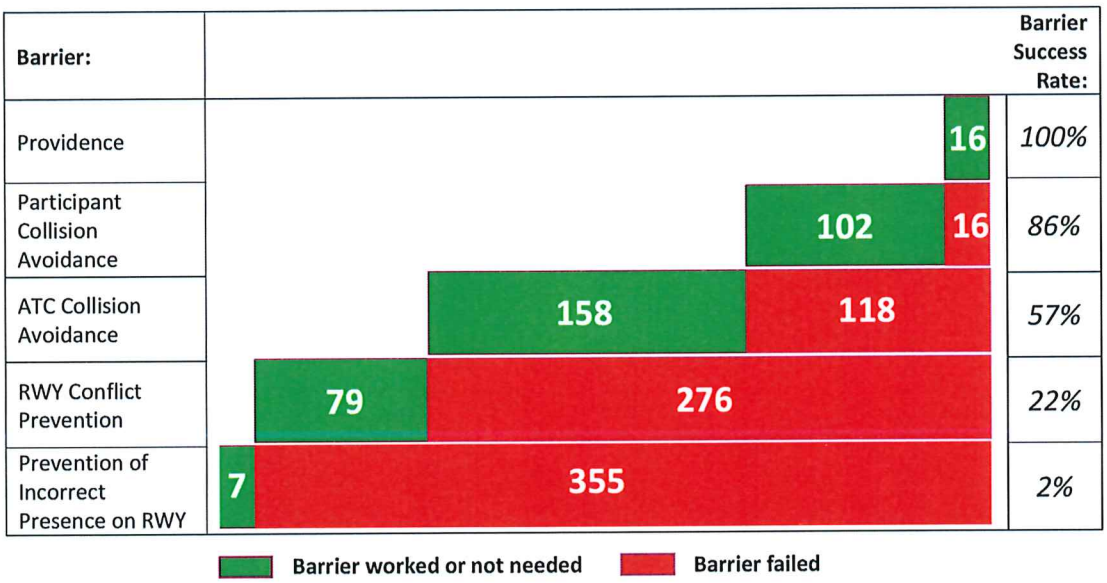

Figure 2: SAFMAP rarrier resilience of the overall studied sample of incidents

(3) Here are some of the main findings of the 9-year SAFMAP study:

- 50% of the incidents (8 of 16) in the sample prevented only by 'Providence' involved Controller not detecting potential runway conflict.
- 'ATC Collision Avoidance barrier' was efficient (prevented) for 57% of the events that challenged it. For the events that involved Controller not detecting potential runway conflict the 'ATC Collision Avoidance barrier' was only efficient for 46% of the events that challenged it.

(4) Of the 362 incidents sampled:

- 17 incidents could have been prevented by ATC detecting a potential conflict with other, previously authorised, traffic before clearing taxiing traffic to the RWY.
- 63 Incidents could have been prevented by ATC detecting a potential conflict with other traffic before clearing an aircraft to take-off.
- 68 incidents could have been prevented by ATC detecting a potential conflict with other traffic before clearing an aircraft to land.

(5) Overall, 41% of all serious runway incursion incidents involving other traffic could have been prevented by ATC detecting a potential conflict before clearing an aircraft to the RWY.

(6) For the 148 reviewed events that could have been prevented by controller detection of runway conflicts:

- 38% involved vehicles.
- 4% occurred while on-the-job training was being conducted.
- 10% reported weather as a factor.
- 6% occurred during position take over/hand over.
- 11% reported controller workload as a factor.
- 10% reported low visibility procedures (LVP) as a factor.

(7) For the 17 incidents that could have been prevented by ATC detecting a potential conflict with other, previously authorised, traffic before clearing taxiing traffic to the RWY the following observations were identified in incident reports:

- Forgetting take-off clearance.
- Overlooking the flight information.
- Landing clearance issued far on approach.
- Distraction during low traffic period.
- Single person operations.

(8) For the 63 Incidents that could have been prevented by ATC detecting a potential conflict with other traffic before clearing an aircraft to take-off the following observations were identified in incident reports:

- 15% - occurred after an authorised presence on the RWY and 2% - after unauthorised presence on the RWY.
- 30 incidents involved vehicles.
- Memory aids not used or not identified.
- Confusion in a group of vehicles.
- Long-time runway presence.
- RWY inspection not opposite the RWY use direction
- Vehicle colour not conspicuous
- ASMGCS alerting not available or switched off.
- Almost all in good visibility.

(9) For the 68 incidents that could have been prevented by ATC detecting a potential conflict with other traffic before clearing an aircraft to land the following observations were identified in incident reports:

- ❑ People on RWY difficult to detect.
- ❑ Single person operations.
- ❑ 15% - occurred after an authorised presence on the RWY and 4% - after unauthorised presence on the RWY.
- ❑ 30 incidents involved vehicles.
- ❑ 10 incidents involved ILS critical area not cleared.
- ❑ 21 incidents involved previously lined-up aircraft.
- ❑ 12 incidents happened during LVP.
- ❑ Memory aids not used or not identified.
- ❑ ASMGCS alerting not available or switched off.
- ❑ Obstructed line of sight.

(10) ANSPs are encouraged to review these findings and evaluate their relevance for their specific operations.

9 How Can you Identify Issues in Your Operations?

(1) We have covered what the data on a larger scale has shown, but what about your particular operation? Every operation is unique and has elements that may prove more, or less, resilient to any given safety issue. Current data (2013- 2021) shows that controller detection incidents are consistent as a significant portion of all A and B runway incursion incidents.

(2) A thorough review of your ANSP's data around controller detection of potential runway conflicts may be wise. Even if you have it well managed, we know that human behaviour does drift, and controller detection issues are often a human performance issue.

The important questions to answer are:

- ❑ What types of scenarios are you most likely to see?
- ❑ Where are you most likely to see them?

(3) Answering these questions will help you understand where to focus your mitigation efforts.

10 A Process to Evaluate the Risk in Your Operations

Collate controller detection of potential runway conflict related incident data

(1) It is necessary to start with information about incidents that have occurred in your operation over the past few years. Identify any that fit the scenarios defined above.

Validate the data with investigation reports

(2) Review the investigation reports associated with the events you have identified. Make sure the findings are consistent with controller detection incidents to ensure you are using the right information for your analysis.

Review your operational environment

(3) You may not have enough data in your reported incidents, or there may be other factors in play in your operation. Perhaps controller detection scenarios are present but not resulting in negative consequences yet. The study team should examine the operation and attempt to identify the prevalence of controller detection of potential runway conflict scenarios.

Controller detection of potential runway conflict scenarios

(4) Identify the controller detection scenarios present in your operation based on your safety data and analysis. Those listed below are the most frequent but be open to other scenarios that may be present and may be unique to your operation:

- ❑ Runway conflict could have been prevented by ATC potential conflict detection before clearing taxiing traffic or person to enter RWY.
- ❑ Runway conflict could have been prevented by ATC potential conflict detection before clearing an aircraft to land or to take-off.
- ❑ Runway conflict could have been prevented by ATC recognising potential conflict between 2 aircraft landing/departing intersecting runways.
- ❑ Runway conflict could have been prevented by ATC recognising potential conflict from aircraft entering/landing/departing a closed runway.

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