EUROPEAN ORGANISATION
FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

Runway Incursion Prevention
Air / Ground Communications

Edition Number	**:**	**1.0**
Edition Date	**:**	**February 2010**
Status	**:**	**Released**
Intended for	**:**	**General Public**

COOPERATIVE NETWORK DESIGN

DOCUMENT CHARACTERISTICS

TITLE		
	Publications Reference:	
	ISBN Number:	
Document Identifier	**Edition Number:**	1.0
	Edition Date:	15 February 2010

Abstract

Keywords

Runway incursion Communications

Authors

Contact(s) Person	Tel	Unit
Yvonne Page	02 729 3789	CND/COE/ATM/APT

STATUS, AUDIENCE AND ACCESSIBILITY					
Status		**Intended for**		**Accessible via**	
Working Draft	☐	General Public	☑	Intranet	☐
Draft	☐	CND Stakeholders	☐	Extranet	☐
Proposed Issue	☐	Restricted Audience	☐	Internet (www.eurocontrol.int)	☑
Released Issue	☐	*Electronic copies of this document can be downloaded from : www.eurocontrol.int/runwaysafety*			

DOCUMENT APPROVAL

The following table identifies all management authorities who have successively approved the present issue of this document.

AUTHORITY	NAME AND SIGNATURE	DATE
Project Manager Runway Safety	Yvonne Page	15 March 2010
Deputy Head of Unit CND/COE/ATM/APT	Philippe Joppart	15 March 2010
Head of Unit CND/COE/ATM/APT	Peter Eriksen	15 March 2010

DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION NUMBER	EDITION DATE	REASON FOR CHANGE	PAGES AFFECTED
1.0	15 March 2010	First release	All

Publications

EUROCONTROL Headquarters

96 Rue de la Fusée

B-1130 BRUSSELS

Tel: +32 (0)2 729 1152

Fax: +32 (0)2 729 5149

E-mail: publications@eurocontrol.int

Contents

EXECUTIVE SUMMARY

As understanding of runway incursions grows, so do the number of reports available for fact based analysis and discovery of lessons learned.

- A review was made of 482 runway incursion incidents that took place in the period 2005-2009, in one European state. 53 cases were studied.

The top three communications related causes were:

- Entering the runway without a valid clearance;
- Non ICAO compliant phraseology use;
- A clearance/instruction/coordination misunderstood or ignored.

The findings of this study showed that:

1. Most incursions attributed to entering a runway without a valid clearance involved vehicles.
2. The majority of incursions using non ICAO compliant phraseology involved pilots who regularly use an aerodrome.
3. Pilots most commonly incurred where the clearance, coordination or other exchange was correctly given and acknowledged, but followed by a contrary / unpredictable action.
4. Forgetting about or misunderstanding about occupied runways happens most often when vehicles are on the runway or parts of the aerodrome are delegated to the aerodrome operator.
5. When pilots forget to readback or give only a partial readback the air traffic controller often overlooks to insist on the correct communication or take other action to prevent further movement until certain of correct understanding of the instruction.

Recommendations proposed in this report address the need to ensure that adequate information is collected on all incidents so that causal and contributory factors can be identified, lessons can be learned and disseminated e.g., in Case Studies created for training purposes.

Every runway incursion should be reviewed by the Local Runway Safety Team to ensure robust solutions are implemented.

Recommendations specific to communication breakdown have been extracted from the European Action Plan for the Prevention of Runway Incursions. There is still work to do to comply with ICAO provisions and provide adequate training to enable operational staff to work in a safe and effective manner.

Finally, in addition to reviewing and improving local procedures and working practices, technology could be applied to provide simultaneous runway and traffic proximity alerts for Pilots, Air Traffic Controllers and Drivers.

CHAPTER 1 – INTRODUCTION

1.1 Background

Using the following ICAO definition of a Runway Incursion, analysis of incursion incidents can now be analysed and discussed on the basis of some common understanding:

"Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft."

Reports on runway incursions show that communication breakdown leads to the human error that may result in a runway incursion. Communications is considered as the transfer of information important to operations on the manoeuvring area, irrespective of its timing, that led to a runway incursion. In this respect, the lack of information transfer, when in fact there should have been such transfer, is also considered as belonging to the concept of communications as defined for the study.

A review was made of 482 runway incursion incidents that took place in the period 2005-2009, in one European state. 53 cases were retained to be analysed in more detail. Causal Factors were grouped into 15 categories.

1.2 Objectives

The objective of the study was to determine if there are key phrases or communications procedures and practices at aerodromes that lead to misunderstandings and runway incursions.

1.3 Purpose

Communication breakdown on the manoeuvring area has repeatedly been shown to be a primary causal factor leading to runway incursions. The purpose of this study was to learn more about how to prevent communication breakdown and prevent runway incursions.

1.4 Information source

This study looks at the runway incursion reports of one European air navigation service provider. *Note: Current practices permit access to voice recordings only when a formal investigation has been initiated, consequently many reports do not have the phraseology used attached to the incident report.*

1.5 Scope

This study looked at runway incursion reports from several major and some secondary international airports with the variety of traffic composition, weather conditions and operating procedures typical of the European environment from January 2005 to December 2009 inclusive.

CHAPTER 2 –Overall figures

2.1 The top three causes

The top three causes of runway incursions identified by this study are:

1. Confusing signs and markings;
2. Intersecting or closely spaced parallel runways;

   The issue hare are aircraft that come off one runway and then need to stop outside the protected zone of the other runway when the distance available to do this is too short for certain aircraft types;
3. Non ICAO compliant phraseology.

2.2 Overview of events

A total of 482 events were reviewed, representing all the reported runway incursion events in the period 2005-2009 (up to 10 December 2009), 53 were selected for further consideration.

2.3 Prevailing circumstances

2.3.1 Weather

The analysis has shown that most runway incursions happened in airport Visual Meteorological Conditions. Only six of the 53 incidents occurred in airport Instrument Meteorological Conditions. One incident took place in low visibility conditions.

2.3.2 Time of day

In the sample analysed, most incursion events took place in daylight (including morning and evening twilight) conditions. Of the 53 communications related events, 11 took place during darkness.

2.3.3 Aircraft types and operators

The majority of incidents involved aircraft of the Boeing 737/Airbus A320 type family with a very small percentage (less than 3 %) of light airplanes, military and rotorcraft.

Airlines involved in these runway incursions had regular fights to the airports concerned.

CHAPTER 3 – Event details

.

3.1 Contributory factors

3.1.1 Enters or crosses a runway without a valid clearance

In the sample studied, one third of all events can be categorised as “entering or crossing the runway without a clearance”. The underlying causes identified are listed below, in the order of frequency of occurrence:

- Lack of awareness of or ignoring the protected nature of runways;
- Misunderstandings;
- Forgetting;
- Vehicle driver not familiar with the airport
- Decisions based on assumptions rather than knowledge (e.g. the applicable procedures);

3.1.1.1 Occurrence percentage

32 %

3.1.1.2 Examples

- Aircraft crossed the active runway while still on apron frequency.
- Works started on a taxiway with outside personnel. Both workers and vehicles went beyond the holding point without approval.
- Snow removal team still working on one of the runways informs the Tower that runway xx would be the next. They continue on the original runway and then proceed to runway xx without further communication with the Tower.
- An aircraft calls for a doctor. The fire brigade responds with three cars rushing to where the aircraft is parked, crossing the active runway in the process without obtaining a clearance to do so.
- A number of vehicles requested clearance to move around the taxiways as a group. There was no explicit mention of crossing runways. They did cross the active runway without communicating with the Tower.
- A vehicle belonging to the airport operator drove on the active runway without any communication with the Tower.
- The fire brigade took two heavy vehicles for a test drive. They entered the active runway without any communication with the Tower.
- A Follow-me vehicle enters the runway safety area without radio contact

with anyone.

- Construction works started near the runway. A dedicated safety post was established and manned. The safety post did not communicate traffic movements to the tower.
- A vehicle belonging to a third party company enters the runway not in use in a given period due to noise abatement rules without clearance. When challenged later, the driver had assumed that there was no requirement to obtain a clearance for entering a runway that was not in use.
- A runway was temporarily closed and this was announced also in the Automatic Terminal Information Service (ATIS) broadcast. Some time later the runway was reopened. Due to a ground navigation error an aircraft deviated from its assigned taxi route and crossed the "closed" runway (which was by that time open again). The pilot later said that for them the runway was closed since that is what the ATIS broadcast said. The Air Traffic Services (ATS) authority was of the opinion that the ATIS was not an absolute source of information as things can change and the changes are not necessarily and immediately reflected in the ATIS broadcast.
- An aircraft crossed a runway without clearance. Investigation revealed that the runway was erroneously shown in the airline support information as closed.
- A vehicle driver not familiar with the airport layout was given various clearances which he acknowledged but then just proceeded his own way.
- A driver licensed for one day crosses the threshold two times due to disorientation.
- A Follow-Me vehicle and an armoured car are escorting an aircraft that is accorded heightened security. Without warning the armoured vehicle overtakes the Follow-Me car and blunders onto the runway.
- A car is spotted driving down the runway. Its movements are consistent with a runway check. However, there is no communication with the tower. Enquiry launched with apron control revealed that they did not know which car could have been on the runway. The identity of the car was never discovered.
- An aircraft enters a runway in spite of repeated warnings and instructions from the tower. The Tower controller wrote in the report "This guy does not speak English!"

3.1.2 Non ICAO compliant phraseology

Slight variations of standard phraseology, using phrases that are not part of the standard phraseology, using (or mixing in) local language phrases, and misusing key words that are part of ICAO Doc. 4444 have led to runway incursions.

3.1.2.1 Occurrence percentage

24 %

3.1.2.2 Examples

- An aircraft is given the following instruction: "Next left, expedite and cross, contact Tower…" The pilot interpreted this as a clearance to cross the runway. The controller was referring to an intersection and not the runway.

- An aircraft is given the following instruction: “Expect departure three miles behind the Airbus.” An aircraft lines up resulting in a go-around for the next arrival. Pilot thought the clearance was “Behind the Airbus, line up.”
- An aircraft is given the following instruction: “Turn now into x to the holding point.” The aircraft taxied beyond the Cat II holding point in CAT II conditions.
- An aircraft was given climb-out instructions. These were understood to encompass the line-up and take-off clearance also.
- A helicopter was given clearance by apron control to “Airtaxi up to” the helipad. The helicopter taxied on-to the helipad.
- An aircraft was given the following instruction: “Report ready for departure.” This was interpreted as clearance to line up and report when ready and the aircraft lined up without clearance.
- An aircraft was given the following instruction: “Hold short of x and report ready.” There was an aircraft on final 2 miles out. The incident aircraft lined up without a clearance behind the landing.
- An aircraft was given the instruction “Taxi to holding position” whereupon it lined up. This was a US aircraft.
- Use of local language resulted in a series of misunderstandings between a pilot and controller, both are using their mother tongue.
- A ground vehicle requests a clearance to check the runway for the presence of birds. The instructions to the driver are very imprecise and ambiguous, resulting in the vehicle being on an active runway as an aircraft was cleared onto that runway.
- An aircraft reported to the Ground Controller “We are ready for departure”. Ground sends them to the Tower frequency, whereupon the aircraft entered the runway and took-off. This was a small aircraft, one of the few such cases.
- An aircraft taxied one full aircraft length beyond the stop bar guarding the runway at the holding point. An aircraft on the runway started their take-off roll and did not react when the Tower tells them twice to break off the take off.
- An aircraft was issued line-up and take-off clearance. The read-back was incorrect. The take-off clearance was withdrawn, however the aircraft lined up and took off. Calls by the tower had no effect.

3.1.3 Clearance/instruction/coordination misunderstood or ignored

Properly given and acknowledged clearances and instructions, coordination or other exchange is followed by action that is contrary to the cleared/agreed one.

3.1.3.1 Occurrence percentage

17 %

3.1.3.2 Examples

- Aircraft was vectored for landing on an active runway. Once on final, it deviated and landed on a parallel runway, which was closed. The investigation revealed that the information provided to the flight crew about unserviceable facilities such as approach and runway lights was clear.
- An aircraft was given an instruction to hold short, but taxied onto the runway. When instructed to stop, it did stop and the pilot explained that “it

was a very long day".

- An aircraft was instructed to contact the Tower; It never established contact and landed without a clearance.
- An aircraft was cleared to the holding point but overshot the holding position and stopped on its own.
- An aircraft lined up following a clearance given to another aircraft (2 cases).
- A small aircraft slowly rolled towards runway while changing frequency from Ground to Tower.
- A clearance issued to snow removal vehicles was taken by the bus service and they entered the runway.
- An aircraft was cleared to the holding point and transferred from Ground to Tower well before the holding point. There was no readback to the Tower and the aircraft overshot the holding point.
- An airport vehicle had clearance to check one runway and drove onto the other active runway when leaving the runway cleared for inspection. There was an incursion warning to the Controllers, but this was not in the primary field of view of the controller. There was no audible alarm implemented in the system.

3.1.4 Methods for indicating occupied runway and delegation of control

An occupied or delegated runway was not taken into account by the controllers concerned. Methods to show an occupied runway were available to these Air Traffic Controllers, but not used.

3.1.4.1 Occurrence percentage

8 %

3.1.4.2 Examples

- An airport vehicle was cleared to enter the runway via the common ground frequency. An aircraft was cleared to take off but this was not heard by the driver of the car which was on the airport common frequency. The controller forgot that the car was on the runway.
- Control of taxiway X was delegated by position G to position A. Position G forgot the delegation and issued taxi instructions as if it still had control of taxiway X.
- Landing clearance was issued to an approaching aircraft while another aircraft was in the line-up position without a take-off clearance. When the aircraft on the runway said "I am waiting here…" the landing clearance was withdrawn.
- A "Follow Me" vehicle was cleared to drive on an already occupied runway. "Runway Occupied" indicator had not been switched to "Occupied".

3.1.5 Failure to challenge incorrect or incomplete read-back

The read-back either contained an error or was not complete. Neither situation was challenged by the controller.

3.1.5.1 Occurrence percentage

6 %

3.1.5.2 Examples

- An aircraft was given a hold short instruction. The read-back was incomplete and the aircraft lined up.
- Two aircraft responded to the same take-off clearance, but they were on different runways (one runway was behind the controller's back). The controller did not notice the error.
- An aircraft cleared to line-up did not acknowledge. Another aircraft was then cleared to take-off from an intersection ahead of the other (non-responding) aircraft. Both aircraft entered the runway. The "non-responding" aircraft had read back its clearance on the ground frequency with the error unnoticed.

3.1.6 Communications breakdown in or between Units

A ground vehicle or aircraft does something unexpected. The reason is apparently a misunderstanding as each party believes to be doing the correct thing. In the majority of cases no detailed investigation follows since the misunderstanding were seen as unimportant.

3.1.6.1 Occurrence percentage

6 %

3.1.6.2 Examples

- Apron control misunderstood something from the Tower and instructed an aircraft to "start from runway xxL". The aircraft then rolls on the runway and stops with half of the fuselage on the runway resulting in an arrival flying over the first aircraft and landing further down the runway. The taxiing aircraft does not communicate with the Tower.
- An aircraft landed and was instructed by the tower to vacate via taxiway x and then to continue with Apron. On vacating the runway, the aircraft stopped on the taxiway with its tail section still in the safety strip of the runway. Adequate coordination between the Tower and Apron control did not happen.
- An aircraft crossed the active runway. There had been a misunderstanding between a trainee controller and the runway controller.

3.1.7 Loss of communication

A garbled transmission, poor reception, no communication resulted in an incursion as aircraft continued. Where total loss of communications occurred, the procedure for use of signals at an aerodrome, Annex 2, Appendix1, Chapter 4 was not used.

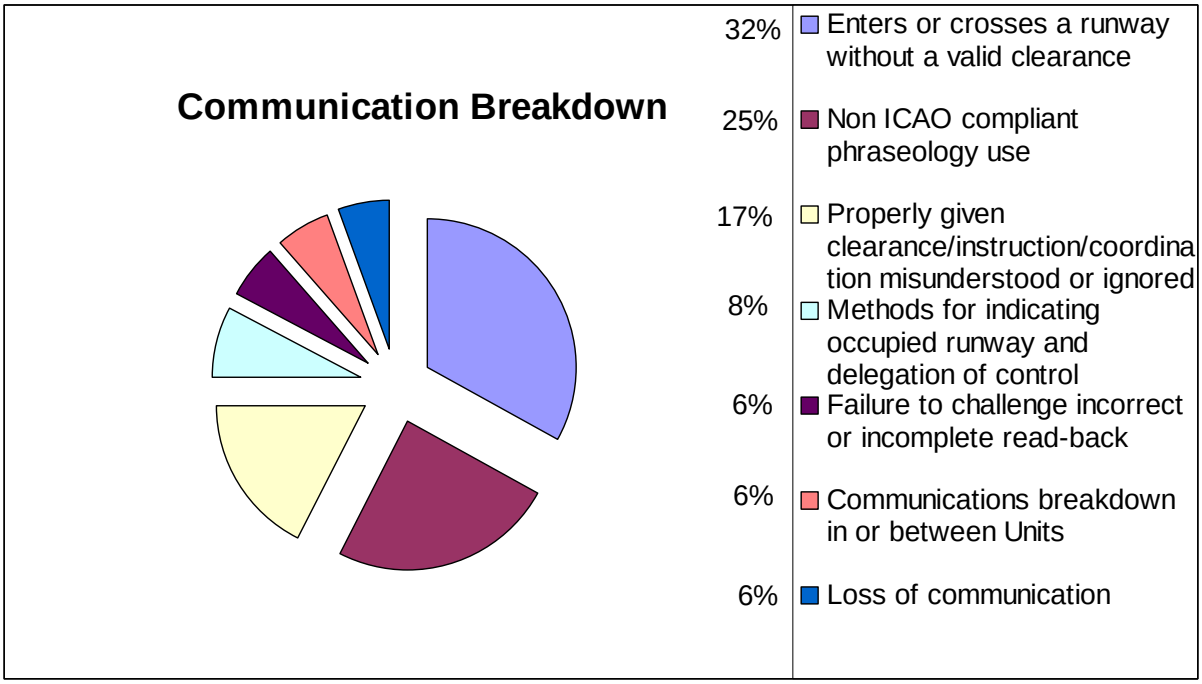
3.1.7.1 Occurrence percentage

6 %

3.1.7.2 Examples

- A helicopter crossed the runway. Communication was very poor due to radio technical problems.
- Aircraft lined up following a garbled transmission.
- The flight crew does not respond to transmissions addressed to them and they taxied beyond the holding point. When challenged, the pilot claims that they have not seen either the holding point markings or the flashing yellow lights.

3.2 Summary of contributory factors



3.3 Alignment with the findings of other studies

The results of this study from a European state validate the results of the study performed by the National Air Traffic Services (NATS) covering 16 airports in the United Kingdom. In particular, the contributory factor “entering runway without clearance” is the number one factor contributing to runway incursions.

The second most important factor is the use of correct aviation English. Aviation English is described in ICAO Annex 11 and doc. 4444.

CHAPTER 4 – Conclusions and recommendations

4.1 Ground Navigation Errors

Investigate what happens just before a runway incursion e.g. look at ground navigation errors and the factors that contribute to them.

4.2 Incident Report data

4.2.1 Quality of information

Every incident report is a valuable insight into aviation safety. Runway incursion reports do lead to incursion prevention measures. What is needed is supporting information such as what the pilot, driver or the controller could see, hear or was experiencing, when the incident took place e.g. a photograph of the intersection and visibility conditions, voice recording transcripts (de-identified as appropriate), a snapshot of the surveillance picture. Follow up interviews do provide more information from which to understand what happened. Today, incident reports typically offer the minimum of information unless considered to be a significant event, i.e. class A, B or accident, when they will become subject to a formal investigation.

4.2.2 Full radiotelephony transcripts

The majority of incident reports do not include the full radiotelephony transcript. Of the reports studied with a transcript, a communication breakdown features in each event. Misunderstandings and poor communication lead to human error. Preventing communication breakdown is an important safety action.

Ensure that adequate information is collected on all incidents so that causal and contributory factors can be identified, lessons can be learned and disseminated e.g., in Case Studies created for training purposes.

Every runway incursion should be reviewed by the Local Runway Safety Team

4.3 Communications breakdown before take-off

Communication breakdowns before take of ranged from garbled transmissions to complete silence from the aircraft. In this study, the aircraft proceeded to line up and take off without clearance. Lack of awareness of the procedures to be applied in the case of communications failure at the aerodrome before take-off is an important shortcoming. The ICAO procedures for communications failure are contained in Annex 10, Annex 2, Appendix 1, Doc 4444, Doc 9426 and Doc.

7030 Regional Supplementary Procedures. Together they provide adequate information.

Consider implementing a regular evaluation of radio telephony practices, by all users looking at such things as frequency loading and use of ICAO compliant phraseology.

Raise awareness of the loss of communications procedure for the manoeuvring area.

4.4 Use of ICAO compliant phraseology and radiotelephony procedures

A large number of events resulted from the use of non ICAO phraseology and not following the prescribed radiotelephony procedures i.e. insisting on correct and complete readback. Additional separation measures are to be taken if clearly understandable two-way communication cannot be established.

Use the ICAO read-back procedure (including Drivers and other personnel who operate on the manoeuvring area).

4.5 Misleading phrases

In addition to using the correct ICAO phraseology, it is good to make operational staff aware of misleading phrases that may incite a pilot to line up and take off, Example Phrases

“report ready”

“report ready for departure”

“taxi to holding position”

“hold short”

Pilots have misunderstood key words such as ‘ready’, ‘departure’, ‘hold’. ‘Hold’ or ‘holding’ may be associated with the FAA phraseology taxi into position and hold, meaning line up and wait from ICAO doc. 4444.

Verify the use of standard ICAO RTF phraseologies.

4.6 Complex instructions

Use of complex instructions means long taxi routings, more than two actions and two sets of numbers, misapplied conditional clearances or information that is intended to anticipate the use of a gap in traffic or a sequence of traffic.

Ensure that ATC communication messages are not over long or complex.

Ensure that ATC procedures contain a requirement for explicit clearances to cross any runway.

Includes non-active runways.

4.7 Methods to show an occupied or delegated runway

The equipment provided for the Tower controller to show an occupied runway is standard at all air traffic control towers for this air navigation service provider. Its consistent use may be hampered by local practices, procedures and occasionally inadequate layout of working positions. The equipment is there to prevent human error i.e. forgetting about a vehicle or a previously given clearance.

Ensure a robust procedure, and where practicable, appropriate technology to show an occupied runway.

4.8 Driver training

The number of runway incursions caused by communication breakdown with drivers operating on or near a runway invites a review of aerodrome procedures, communication practices, manoeuvring area driver training, and standardisation of local practices to harmonise with global ICAO aviation safety guidance e.g. doc. 9870, the Runway Incursion Prevention Manual and standards and recommendations from other ICAO provisions. This conclusion applies equally to temporary or infrequent drivers or teams of drivers / workers as to slightly unusual weather conditions such as low visibility.

Introduce a formal Driver training and assessment programme, or where already in place review against driver training guidelines.

Introduce formal communications training and assessment for Drivers and other personnel who operate on or near the runway.

4.9 Aeronautical information

Misinforming operational staff about the status of a runway or section of the manoeuvring area can to lead to wrong runway selection and other ground navigation errors.

Regularly review all aeronautical information provided to ensure it is up to date and relevant to the pilot.

4.10 Signs, marking and lighting

Landing on (or taking off from) the wrong strip of concrete or a closed runway happens infrequently. Inappropriate use of lighting is mentioned as a factor in ground and airborne navigation error during take off and landing at aerodromes.

Confirm that all infrastructure, practices and procedures relating to runway operations are in compliance with ICAO provisions.

This study found that home base / local airlines were often involved in runway incursions.

A local runway safety awareness campaign should be initiated at each aerodrome for Air Traffic Controllers, Pilots and Drivers and other personnel who operate on or near the runway. The awareness campaign should be periodically refreshed to maintain interest and operational awareness.

4.11 Training

Make full use of the training and guidance material available from ACI, ICAO and EUROCONTROL, IATA, IFALPA, FAA making sure also that the guidance is implemented and correctly applied in practice. Apply it locally.

Runway safety should be part of initial and recurrent training for operational staff e.g. Air Traffic Controllers, Pilots, vehicle Drivers and all other personnel involved in manoeuvring area operations.

4.12 Improve situational awareness

Loss of situational awareness describes not knowing the position / location of the aircraft or vehicle under your responsibility nor its proximity to other traffic. It has been shown by this study that loss of situational awareness is an important factor contributing to runway incursions.

Improve situational awareness by adopting the use of technologies that enable operational staff on the manoeuvring area to confirm their location in relation to the runway e.g. via GPS with transponder or airport moving maps, visual aids, signs etc.

Promote the integration of safety nets to provide immediate and simultaneous runway and traffic proximity alerts for Pilots, ATC and Drivers.