ICAO

SAFETY

Runway Safety Programme – Global Runway Safety Action Plan

November 2017

Contents

Background

Since the first ICAO Global Runway Safety Symposium held in Montréal, Canada, in May 2011, ICAO and the Runway Safety Programme (RSP) Partners have been working together to minimize and mitigate the risks of runway incursions, runway excursions and other events linked to Runway Safety.

The ICAO runway safety programme involves substantial collaboration with partner organizations including: Airports Council International (ACI); the Civil Air Navigation Services Organisation (CANSO); the European Aviation Safety Agency (EASA); European Organisation for the Safety of Air Navigation (EUROCONTROL); the United States Federal Aviation Administration (FAA); the Flight Safety Foundation (FSF); the International Air Transport Association (IATA); the International Business Aviation Council (IBAC); the International Coordinating Council of Aerospace Industries Associations (ICCAIA); the International Council of Aircraft Owner and Pilot Associations (IAOPA); the International Federation of Airline Pilots' Associations (IFALPA); and the International Federation of Air Traffic Controllers' Associations (IFATCA).

In January 2017 the RSP Partners established a Runway Safety Action Plan Working Group (RSAP-WG) with the aim of reviewing the RSP achievements, objectives and priorities, and to develop a global runway safety action plan to be unveiled at the Second Global Runway Safety Symposium in Lima, Peru, 20-22 November 2017. The objectives of the RSAP-WG included:

- Review runway related accident and serious incident data;
- Conduct a safety risk assessment of runway safety accident occurrence categories;
- Identify the runway safety risk priorities and high risk accident categories;
- Identify appropriate global mitigation actions; and
- Develop a Global Runway Safety Action Plan.

Through a review and analysis of runway safety occurrence data and risk analysis, the RSAP-WG identified runway excursions and runway incursions as the main high risk occurrence categories. This Global Runway Safety Action Plan provides recommended actions for all runway safety stakeholders, with the aim of reducing the global rate of runway excursions and runway incursions.

Runway Safety Teams

The Runway Safety Programme promotes the establishment of Runway Safety Teams (RSTs) at airports as an effective means to reduce runway related accidents and incidents. The requirement for airports to establish a RST was one of the main outcomes of the first ICAO Global Runway Safety Symposium held in Montréal, Canada, in May 2011. The establishment of effective RSTs has helped to significantly reduce the runway safety related risks globally since 2011, with over 200 international airports world-wide having registered a RST with ICAO.

The Runway Safety Programme Partners continue to support the establishment of effective RSTs with Runway Safety Go-Team Missions. To register a RST or to request a Runway Safety Go-Team Mission please visit https://www.icao.int/safety/RunwaySafety.

Other ICAO Initiatives

ICAO is currently undertaking several other initiatives related to improving runway safety. In 2020 an amendment to Annex 14 Vol I will

become applicable outlining an enhanced global reporting format for assessing and reporting runway surface conditions. It is hoped that this enhanced reporting system will significantly reduce the risks associated with runway contamination, one of the leading contributing factors of runway excursions.

A third edition to the ICAO PANS-Aerodrome (Doc 9981) is planned to be released in 2018 that will include a new chapter on Runway Safety.

ICAO is also working to enhance its Safety Management Programme activities, including an amendment to the ICAO Safety Management Manual (SMM)(Doc 9859), launching of a new Safety Management Implementation (SMI) website, updated State Safety Programme (SSP) tools and organising Safety Management Regional Symposia and Workshops.

Global Priorities for Runway Safety

The current edition of the Global Aviation Safety Plan (GASP) identifies runway safety as a global safety priority. Runway safety-related events as defined in the GASP and ICAO Annual Safety Report, include the following ICAO accident occurrence categories:

- Abnormal Runway Contact
- Bird Strike
- Ground Collision
- Ground Handling
- Runway Excursion
- Runway Incursion
- Loss of Control on the Ground
- Collision with Obstacle(s)
- Undershoot / Overshoot
- Aerodrome

The ICAO definitions of each runway safety occurrence category may be found in Appendix 1.

In line with safety management principles the RSAP-WG conducted an analysis of available runway safety accident and serious incident data and conducted a risk assessment to identify the runway safety high risk categories, in order to prioritize the efforts of the Runway Safety Programme.

The result of the analysis identified runway excursions as the highest risk category with a total risk weight significantly higher than all other categories (see Appendix 2 Table 1).

ICAO and Runway Safety Partners have also identified runway incursions as a high risk category. Although the number of runway incursion accidents reported between the period of 2008 to 2016 is very low, the number of runway incursion incidents remains high (at a rate of 1 report per day according to IATA STEADES data). There is a very high fatality risk associated with runway incursion accidents. The collision between two B747s at Los Rodeos Airport, Tenerife, in 1977, was the result of a runway incursion and remains the worst accident in aviation history, with the highest number of fatalities.

Although the Runway Safety Programme will focus efforts on the runway safety high risk categories, runway excursions and runway incursions, the other runway safety categories should not be forgotten. Aerodrome runway safety teams and safety management systems should continue to focus on all the runway safety accident categories.

This action plan provides recommended actions for runway stakeholders, including ICAO, the runway safety programme partners, State Civil Aviation Authorities, Regional Safety Oversight Organisations (RSOOs), Regional Aviation Safety Groups (RASGs), aircraft operators, aerodrome operators, air navigation service providers and aircraft manufacturers. The actions detailed in this document are aimed at reducing the global rate of runway excursions and runway incursions. However, regions,

States and industry may have their own unique challenges, therefore the actions are not all encompassing. States, regions and industry should conduct their own regular risk analyses to identify their own operational safety risks and appropriate mitigations.

Runway Excursion and Runway Incursion Top Contributing Factors

The following tables present the top contributing factors for runway excursions and runway incursions. The RSAP-WG identified the top contributing factors by reviewing available data and information provided by Runway Safety Programme partners as well as through expert assessment. The references used for the analysis can be found in Appendix 3.

An analysis of runway excursion contributing factors performed by IATA and shared with the RSAP-WG was utilized as the basis for identifying the runway excursion contributing factors. Runway excursions, as per IATA, include landing overruns, take-off overruns, landing veer-offs, take-off veer-offs and taxiway excursions. IATA, through the Accident Classification Technical Group (ACTG), assigns contributing factors to runway/taxiway excursion accidents to better understand the correlations. Those common runway excursion contributing factors follow the Threat and Error Management (TEM) framework. The top contributing factors can be found in *IATAs Annual Safety Report – 2016, Addendum A: Top Contributing Factors – Section 4*.

Runway Excursion Top Contributing Factors (2012-2016)

Contributing Factor	Description / Examples
Latent Conditions – *Conditions present in the system before the accident and triggered by various possible factors.*	
Flight Operations: Standard Operating Procedures and Checking	Inadequate or absent: • Standard Operating Procedures (SOPs) • Operational instructions and/or policies • Company regulations • Controls to assess compliance with regulations and SOPs
Flight Operations: Training systems	Inadequate training of flight crews.
Regulatory Oversight	Inadequate regulatory oversight by the State.
Safety Management	Absent or ineffective: • Safety policy and objectives • Safety risk management (including hazard identification process) • Safety assurance (including Quality Management) • Safety promotion

Contributing Factor	Description / Examples
Threats – An event or error that occurs outside the influence of the flight crew, but which requires crew attention and management if safety margins are to be maintained. ***Mismanaged threat: A threat that is linked to or induces a flight crew error.***	
Meteorology	Includes thunderstorms, poor visibility/Instrument Meteorological Conditions (IMC), wind, wind shear, gusty wind and icing conditions
Airport Facilities - Contaminated Runway/Taxiway	Poor braking action as a result of contaminated runways/taxiways.
Flight Crew Errors (Active Human Performance) – An observed flight crew deviation from organizational expectations or crew intentions. ***Mismanaged error: An error that is linked to or induces additional error or an undesired aircraft state.***	
Failure to go-around after Destabilisation during Approach	Flight crew does not execute a go-around after stabilization requirements are not met.
Manual Handling/Flight Controls	• Hand flying vertical, lateral, or speed deviations • Approach deviations by choice (e.g., flying below the glide slope) • Missed runway/taxiway, failure to hold short, taxi above speed limit • Incorrect flaps, speed brake, autobrake, thrust reverser or power settings
Standard Operating Procedures (SOP) Adherence	• Intentional or unintentional failure to cross-verify (automation) inputs • Intentional or unintentional failure to follow SOPs • Pilot flying makes own automation changes • Sterile cockpit violations
Undesired Aircraft States (UAS) – A flight-crew-induced aircraft state that clearly reduces safety margins; a safety-compromising situation that results from ineffective error management. An undesired aircraft state is recoverable. ***Mismanaged UAS: A UAS that is linked to or induces additional flight crew errors.***	
Unstable Approach	Vertical, lateral or speed deviations in the portion of flight close to landing. *Note: This definition includes the portion immediately prior to touchdown and in this respect the definition might differ from other organizations. However, accident analysis gives evidence that a destabilization just prior to touchdown has contributed to accidents in the past.*
Long/floated/bounced/firm/off-center/crabbed landing	

Runway Incursion Top Contributing Factors

Contributing Factor	Description / Examples
Latent Conditions – *Conditions present in the system before the accident and triggered by various possible factors.*	
Training	Includes inadequate training for air traffic controllers, pilots or airside vehicle drivers.
Procedures	Inadequate, inappropriate or absent procedures.
Regulatory Oversight	Inadequate regulatory oversight by the State.
Safety Management	Absent or ineffective safety management.
Aerodrome Design	Complex or inadequate aerodrome design such as the complexity of the layout of roads and taxiways adjacent to the runway, intersecting/crossing runways, insufficient spacing between parallel runways, departure taxiways that fail to intersect active runways at right angles, and no end-loop perimeter taxiways to avoid crossings. Inadequate or poorly maintained visual aids (including signs, marking and lighting). Poorly maintained runways (friction etc.).
Workplace Conditions	Covers issues such as the 'sterile cockpit' environment when pilots are taxiing. For air traffic controllers human-machine interface and ergonomics affecting their ability to maintain, as far as practicable, a continuous 'heads up' visual scan of the aerodrome with unimpeded visual 'lines of sight' or the use of surveillance systems such as A-SMGCS.
Threats – An event or error that occurs outside the influence of the flight crew, but which requires crew attention and management if safety margins are to be maintained.	
Meteorology	Includes poor visibility, rain, snow and icing conditions (that may obscure visual aids).
Active Human Performance – Human Performance Limitations (directly related to OSF and CC) including false perceptions; memory lapses; and reduced situational awareness.	
Pilot Factors	Includes inadvertent non-compliance with ATC instructions, in particular take-off or landing without clearance.
Airside Vehicle Driver Factors	May include not obtaining a clearance or non-compliance with ATC instructions.
Air Traffic Controller Factors	May include clearing aircraft to land/depart on an occupied runway, not monitoring aircraft position on approach to intersecting runways and clearing aircraft to cross runway with aircraft on departure/landing roll.
Communication Errors	A breakdown in communications between air traffic controllers and pilots or airside vehicle drivers often related to the read-back/hear-back procedure.

Runway Safety Recommended Actions

The following tables contain the global runway safety recommended actions identified by the RSAP-WG. These actions are intended to assist runway safety stakeholders in reducing their risks related to runway excursions and runway incursions. Each table identifies the mitigation actions for each stakeholder and associates the actions with the top contributing factors.

The timelines for the actions are categorized by colour into short-term actions, medium-term actions and long-term actions. Those actions without a colour indicator are considered to be on-going actions or best practices. The colour categorization is indicated in the table below.

	Target	Colour indicator
Short-Term	By 2020	
Long-Term	By 2022	

Stakeholder	**ICAO**	
Runway Safety Priority	**Runway Excursions, Runway Incursions**	
Actions	**Action**	**Related Contributing Factor (if applicable)**
	1. Continue to coordinate the Runway Safety Programme.	**Latent Conditions** Training Regulatory Oversight Safety Management
	2. Update and enhance the Assembly Resolution related to runway safety (A37-6).	
	3. Develop runway safety standards and recommended practices for inclusion in ICAO Annex 14 Vol I.	
	4. Publish the third edition of PANS-Aerodrome to include a dedicated chapter on runway safety.	
	5. Review, enhance and consolidate, as appropriate, ICAO recommended practices related to runway safety, such as the Manual on the Prevention of Runway Incursions (Doc 9870), ICAO Runway Safety Team Handbook, Runway Safety Go-Team Methodology etc..	
	6. Review and develop, as appropriate, runway safety recommended practices related to runway excursions.	
	7. Review and develop, as appropriate, guidance to States on the implementation of State Runway Safety Programmes.	
	8. Review and develop, as appropriate, ICAO aviation training related to runway safety, including for runway excursion prevention.	
	9. Continue to maintain and enhance the ICAO runway safety website and I-Kit.	
	10. Conduct Regional Safety Management Symposia and workshops to include runway safety.	
	11. Develop tools, as appropriate, for monitoring and sharing runway safety data, such as web applications in the ICAO integrated Safety Trend Analysis and Reporting System (iSTARS).	
	12. Deploy the Global Reporting Format for assessing and reporting runway surface conditions in accordance with Annex 14 Vol I (Applicability date 5 November 2020).	**Threats** Contaminated runway/taxiway
References	ICAO Annex 14 Vol I ICAO PANS-Aerodromes (Doc 9981) ICAO Manual on the Prevention of Runway Incursions (Doc 9870) ICAO Runway Safety Team Handbook Second Edition Runway Safety IKit (www.icao.int/safety/RunwaySafety)	

<table>
<tr><td>Stakeholder</td><td colspan="2">Runway Safety Programme Partners</td></tr>
<tr><td>Runway Safety Priority</td><td colspan="2">Runway Excursions, Runway Incursions</td></tr>
<tr><td rowspan="3">Actions</td><td>Action</td><td>Related Contributing Factor (if applicable)</td></tr>
<tr><td>1. Continue to convene Runway Safety Programme Partner meetings at least annually to coordinate and collaborate on global runway safety related activities.

2. Continue to collaborate on the monitoring of runway safety related data, conduct analysis and identify appropriate mitigations.

3. Promote runway safety best practices and conduct awareness campaigns as appropriate.

4. Organize a global runway safety event at least every six years so long as runway safety continues to be identified as a global priority in the ICAO Global Aviation Safety Plan (GASP).</td><td>General Actions</td></tr>
<tr><td>5. Actively engage in RASG safety risk management activities related to runway safety.

6. Continue to support the establishment of effective Airport Runway Safety Teams (RST) with RST Go-Team Missions.</td><td>Latent Conditions
Regulatory Oversight</td></tr>
<tr><td>References</td><td colspan="2">ICAO PANS-Aerodromes (Doc 9981)
ICAO Safety Management Manual (Doc 9859)
ICAO Manual on the Prevention of Runway Incursions (Doc 9870)
ICAO Runway Safety Team Handbook Second Edition
Runway Safety IKit (www.icao.int/safety/RunwaySafety)</td></tr>
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Stakeholder	**Regional Safety Oversight Organisations (RSOOs), Regional Aviation Safety Groups (RASGs)**	
Runway Safety Priority	**Runway Excursions, Runway Incursions**	
Actions	**Action**	**Related Contributing Factor (if applicable)**
	1. Collect and perform analysis of available regional safety data to identify trends, risks and contributing factors. These activities to be reviewed and conducted on a recurring basis to reassess risks. 2. Develop and implement regional action plans based on the results of analysis and develop the means to measure implementation/effectiveness. For example RASGs shall develop: a) Safety Enhancement Initiatives (SEIs) b) Detailed Implementation Plans (DIPs) 3. Monitor and actively manage regional action plans, including: a) Review resources (expertise, capital, systems) requirements b) Facilitate partnerships between regional stakeholders (States, industry, RSOO/PIRGs) c) Update action plans as necessary 4. Identify states that may require support and ensure such support is offered.	**General Actions**
References	ICAO Annex 14 Vol I - Aerodromes ICAO PANS-Aerodrome (Doc 9981) ICAO Runway Safety Team Handbook Second Edition ICAO Safety Management Manual (Doc 9859) Runway Safety IKit (www.icao.int/safety/RunwaySafety) ICAO RASG Website (www.icao.int/safety/Implementation/Lists/RASGSPIRGS) ICAO RSOO Website (www.icao.int/safety/Implementation/Lists/COSCAP_RSOO) The CAST/ICAO Common Taxonomy Team Website (www.intlaviationstandards.org)	

Stakeholder	**State Civil Aviation Authorities, Aircraft Operators, Air Navigation Service Providers, Aerodrome Operators, Aircraft Manufacturers**	
Runway Safety Priority	**Runway Excursions, Runway Incursions**	
Actions	**Action**	**Related Contributing Factor (if applicable)**
	1. Ensure all infrastructure, radio telephony phraseology, practices and procedures relating to runway operations are in compliance with ICAO, Regional and State provisions. 2. Ensure that information is collected on all runway incidents/accidents and perform analysis and risk assessments to identify risks and contributing factors. These activities to be reviewed and conducted on a recurring basis to reassess risks. 3. Develop and implement action plans to mitigate identified risks and monitor the implementation/effectiveness of those action plans. 4. Actively participate in aerodrome local runway safety team (RST) activities. Note: Aerodrome Operators shall establish and lead RSTs. Not applicable to Aircraft Manufacturers. 5. Ensure that there is in place a mechanism of protection of information and non-punitive environment inside RSTs.	**Latent Conditions** Regulatory Oversight
	6. Implement the elements of Safety Management and ensure the implementation of Safety Management Systems is in accordance with the applicable ICAO provisions. 7. Make use of available resources such as the ICAO Safety Management Implementation Website and its safety management tools. 8. Ensure appropriate Safety Management training of staff and make use of available training such as the ICAO Safety Management Training Programme (SMTP).	**Latent Conditions** Safety Management
	9. Ensure runway safety training (e.g. runway excursion/incursion prevention) is part of initial and recurrent/refresher training regimes for all relevant operational staff. Joint training sessions between different stakeholders groups (e.g. pilots and controllers) should be encouraged.	**Latent Conditions** Training
References	ICAO Annex 14 Vol I - Aerodromes ICAO Annex 19 – Safety Managment ICAO PANS-Aerodromes (Doc 9981) ICAO Safety Management Manual (Doc 9859) ICAO Runway Safety Team Handbook Second Edition	

	Runway Safety IKit (www.icao.int/safety/RunwaySafety) ICAO Safety Management Implementation website (www.icao.int/safety/SafetyManagement/Pages/Examples-and-best-practices.aspx) SKYbrary – Runway Excursion and Runway Incursion Portals (www.skybrary.aero) The CAST/ICAO Common Taxonomy Team Website (www.intlaviationstandards.org)

Stakeholder	**State Civil Aviation Authorities**	
Runway Safety Priority	**Runway Excursions**	
Actions	**Action**	**Related Contributing Factor (if applicable)**
	1. Regulators should establish requirements and activities aimed at improving runway safety through a Sate Runway Safety Programme. 2. Ensure the prevention of runway safety accidents and incidents is included in the State's SSP. 3. States that need support in safety oversight should acquire support by an RSOO or other competent organisation. 4. Actively engage in RASG safety risk management activities related to runway safety.	**Latent conditions** Regulatory Oversight
	5. Work with aircraft operators to improve adherence to SOPs. 6. Include requirements for manual flying skills on approach and landing in recurrent training for pilots. 7. Improve foundational aviation knowledge requirements for new pilots.	**Latent Conditions** Flight Ops: SOPs Flight Ops: Training
	8. Establish requirements for operators to define and apply stabilized approach procedures, including criteria suitable for their operations, and for a mandatory go-around to be flown if they are not met and maintained.	**Undesired Aircraft States** Unstable Approach Long/floated landing
	10. Establish requirements for a reporting format for assessing and reporting runway surface conditions in accordance with the ICAO Global Reporting Format in Annex 14 Vol I (Applicability date 5 November 2020).	**Threats** Contaminated runway/taxiway Meteorology
References	ICAO Annex 1 – Personnel Licensing ICAO Annex 14 Vol I - Aerodromes ICAO PANS-Aerodrome (Doc 9981) Final Report to FSF: Go-Around Decision-Making and Execution Project IATA/IFALPA/IFATCA/CANSO Unstable Approaches Risk Mitigation Policies, Procedures and Best Practices European Action Plan for the Prevention of Runway Excursions Edition 1.0 EASA: European Plan for Aviation Safety (EPAS) 2017-2021 Runway Safety IKit (www.icao.int/safety/RunwaySafety) SKYbrary – Runway Excursion Portal (www.skybrary.aero)	

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<tr><td>Stakeholder</td><td colspan="2">State Civil Aviation Authorities</td></tr>
<tr><td>Runway Safety Priority</td><td colspan="2">Runway Incursions</td></tr>
<tr><td rowspan="4">Actions</td><td>Action</td><td>Related Contributing Factor (if applicable)</td></tr>
<tr><td>1. Regulators should ensure that runway safety is included in their safety oversight activities.

2. Ensure the prevention of runway safety accidents and incidents is included in the State’s SSP.

3. States that need support in safety oversight should acquire support by an RSOO or other competent organisation.</td><td>Latent conditions
Regulatory Oversight</td></tr>
<tr><td>4. Actively engage in RASG safety risk management activities related to runway safety.</td><td></td></tr>
<tr><td>5. Ensure that the content of training materials for Pilots, Air Traffic Controllers and Airside Vehicle Drivers includes runway incursion prevention measures and awareness.</td><td>Latent conditions
Training</td></tr>
<tr><td>References</td><td colspan="2">ICAO Annex 19 – Safety Management
ICAO Manual on the Prevention of Runway Incursions (Doc 9870)
ICAO PANS ATM (Doc 4444)
ICAO PANS Aerodromes (Doc 9981)
European Action Plan for the Prevention of Runway Incursions V3.0 (November 2017)
Runway Safety IKit (www.icao.int/safety/RunwaySafety)
SKYbrary – Runway Incursion Portal (www.skybrary.aero)</td></tr>
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Stakeholder	**Aircraft Operators**	
Runway Safety Priority	**Runway Excursions**	
Actions	**Action**	**Related Contributing Factor (if applicable)**
	1. Improve crew resource management (CRM) in both initial and recurrent training to improve decision making, maximize communication and coordination and minimize the chance for errors.	**General Action**
	2. Continuously review SOPs to ensure they are applicable to the operation, up to date and tailored to the operation. 3. Use SMS reporting and line operations safety audit (LOSA) assessments to identify deficiencies in SOPs and SOPs compliance. 4. Work with manufacturers to improve SOPs based on operational experience. 5. Provide SOPs with clear limits and actions to be taken following an approach deviation. 6. Encourage a policy on rejected landing to include pilot training awareness. 7. Ensure that policies, procedures and training follow available best practices. Training may include, but not be limited to, the following: a) Assessment and analysis of non-normal situations not covered by SOPs. b) Effective use of new technologies to determine landing distance in all weather conditions. c) Planning and conducting approaches with appropriate contingency plans. d) Preparing for a go-around in the event of deteriorations of weather conditions. e) Manual flying skills on approach and landing. f) Bounced landing recovery techniques. g) Train pilots in crosswind and tailwind landings up to the maximum manufacturer-certified winds. h) Enhance crew resource management (CRM) in both initial and recurrent training to improve decision making, maximize communication and coordination and minimize the chance for errors.	**Latent Conditions** Flight Ops: SOPs Flight Ops: Training

	8. Review recommendations from available resources to identify ways to increase awareness of weather and airport surface conditions by pilots.	**Threats** Meteorology Contaminated runway/taxiway
	9. Ensure that go-around policies, procedures and training follows available resources and best practices. 10. Encourage the use of manual flying on approach and landing when weather conditions allow to maintain manual manipulation skills. 11. Include awareness of results of approach deviations from SOPs during training. 12. Use root-cause analysis of SOP non-compliance to improve SOPs.	**Active Human Performance** Failure to GOA after Destabilized Approach Manual Handling / Flight Controls SOP Adherence
	13. Establish, implement, and maintain a suitable accident prevention and flight safety program, which includes a comprehensive Flight Data Monitoring (FDM) programme. 14. Work with ANSP/Air Traffic Services Unit (ATSU) to implement procedural changes to systematically reduce the rate of un-stabilized approaches to runways identified as higher risk by FDM data analysis. 15. Equip aircraft with runway overrun awareness and alerting systems, as appropriate.	**Undesired Aircraft States** Unstable Approach Long/floated landing
References	FSF Report: Go-Around Decision-Making and Execution Project FSF Report: Reducing the Risk of Runway Excursions IATA/IFALPA/IFATCA/CANSO Unstable Approaches Risk Mitigation Policies, Procedures and Best Practices European Action Plan for the Prevention of Runway Excursions Runway Safety IKit (www.icao.int/safety/RunwaySafety) FAA Runway Excursions website (www.faa.gov/airports/runway_safety/excursion) IATA Guidance Material for Improving Flight Crew Monitoring (http://www.iata.org/whatwedo/ops-infra/training-licensing/Pages/index.aspx) IATA Runway Excursion Risk Reduction Toolkit (www.iata.org/iata/RERR-toolkit/main.html) SKYbrary - Runway Excursion Portal (www.skybrary.aero) EASA: European Plan for Aviation Safety (EPAS) 2017-2021	

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<tr><td>Stakeholder</td><td colspan="2">Aircraft Operators</td></tr>
<tr><td>Runway Safety Priority</td><td colspan="2">Runway Incursions</td></tr>
<tr><td rowspan="4">Actions</td><td>Action</td><td>Related Contributing Factor (if applicable)</td></tr>
<tr><td>1. Provide training and assessment for pilots regarding aerodrome signage, markings and lighting.
2. Ensure SOPs are clear, concise and follow available best practices and guidance.
3. Ensure pilots are made aware of any safety significant airport information.</td><td>Latent conditions
Training
Procedures
Active Human Performance</td></tr>
<tr><td>4. Make use of suitable technologies to assist in improving situational awareness especially during low-visibility operations, such as Improved Resolution Airport Moving Maps, Electronic Flight Bags, Enhanced Vision Systems and Head up Displays (HUD).</td><td>Threats
Meteorology
Active Human Performance</td></tr>
<tr><td>5. Assess pilot’s operational radio telephony communications. Areas that should be targeted include, but are not limited to:
a) Ensure all communications associated with runway operations at international airports are in aviation English.
b) Ensuring the use of standard phraseologies in accordance with applicable State regulations and ICAO provisions (e.g. ICAO Manual of Radiotelephony (Doc 9432)).
6. Ensure Pilots are timely and accurately informed of information about aerodrome works.</td><td>Active Human Performance</td></tr>
<tr><td>References</td><td colspan="2">ICAO Annex 10 – Aeronautical Telecommunications
ICAO Manual on the Prevention of Runway Incursions (Doc 9870)
ICAO Manual of Radiotelephony (Doc 9432)
ICAO PANS Ops (Doc 8168)
Runway Safety IKit (www.icao.int/safety/RunwaySafety)
SKYbrary - Runway Incursion Portal (www.skybrary.aero)
European Action Plan for the Prevention of Runway Incursions V3.0 (November 2017)</td></tr>
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<tr><td>Stakeholder</td><td colspan="2">Air Navigation Service Providers</td></tr>
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<tr><td rowspan="3">Actions</td><td>Action</td><td>Related Contributing Factor (if applicable)</td></tr>
<tr><td>1. Review processes covering the timely provision of essential information on aerodrome conditions and other safety significant information such as weather, wind and runway surface conditions.</td><td>Threats
Contaminated runway/taxiway

Meteorology</td></tr>
<tr><td>2. Reduce ATM related risk factors that can contribute to unstable approaches and take appropriate actions (Airspace design/approach, procedures, controller actions and instructions etc.).</td><td>Undesired Aircraft States
Unstable Approach</td></tr>
<tr><td>References</td><td colspan="2">ICAO Annex 11 – Air Traffic Services

ICAO PANS-ATM (Doc 4444)

FSF Report: Go-Around Decision-Making and Execution Project

FSF Report: Reducing the Risk of Runway Excursions

IATA/IFALPA/IFATCA/CANSO Unstable Approaches Risk Mitigation Policies, Procedures and Best Practices

European Action Plan for the Prevention of Runway Excursions Edition 1.0

EASA: European Plan for Aviation Safety (EPAS) 2017-2021

Runway Safety IKit (www.icao.int/safety/RunwaySafety)

FAA Runway Excursions website (www.faa.gov/airports/runway_safety/excursion)

SKYbrary – Runway Excursion Portal (www.skybrary.aero)</td></tr>
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Stakeholder	**Air Navigation Service Providers**	
Runway Safety Priority	**Runway Incursions**	
Actions	**Action**	**Related Contributing Factor (if applicable)**
	1. Ensure that runway safety is included in initial and refresher training for Air Traffic Control staff. 2. Assess and where necessary improve procedures for air traffic controllers and ensure procedures follow available best practices and guidance. Some areas where procedures should be improved include, but are not limited to, the following: a) Procedures that assist to maintain good situational awareness for controllers, pilots and airside vehicle drivers. b) Procedures for when an aircraft or airside vehicle becomes lost or uncertain of its position on the manoeuvring area. c) Procedures for runway inspections. d) Aircraft runway clearance procedures.	**Latent conditions** Training Procedures
	3. Make use of technologies (such as A-SMGCS, stop bars and ARIWS) to improve situational awareness and provide warnings of runway incursions to pilots, controllers and vehicle drivers.	**Active Human Performance** **Threats** Meteorology
	4. Enable controllers to maintain a 'heads up, eyes outside' posture with unimpeded visual lines of sight to all parts of the manoeuvring area as far as practicable, and whilst taking into consideration the availability of technological solutions that can provide an alternative view (e.g. A-SMGCS). 5. Improve the use of controller memory aids to reduce the possibility of controllers issuing conflicting ATC clearances for aircraft, vehicles or persons to occupy the runway. 6. Assess air traffic controllers' operational radiotelephony communications. Targeted areas should include, but not be limited to: a) Ensuring the use of full aircraft or airside vehicle call signs for all runway operation communications. b) Establish and follow procedures to avoid confusion due to same or similar call signs. c) Ensuring the use of standard phraseologies in accordance with applicable State regulations and ICAO provisions (e.g. ICAO Manual of Radiotelephony (Doc 9432)). d) Monitoring and ensuring the proper use of the read back procedure.	**Active Human Performance** **Latent Conditions** Workplace Conditions

	7. Ensure all communications associated with runway operations at international airports are in aviation English. 8. Use a common frequency for runway operations (to increase situational awareness of pilots, drivers, ATCOs).	
	9. Ensure all air traffic controllers are properly informed about planned aerodrome works. 10. Ensure proper coordination between the ANSP and Aerodrome Operator is in place for any planned Aerodrome works. 11. Ensure that all air traffic controllers are aware of identified runway incursion 'Hot Spots' and mitigate the associated risks.	**Latent Conditions** Aerodrome Design **Active Human Performance** Communication Errors
References	ICAO Manual on the Prevention of Runway Incursions (Doc 9870) ICAO PANS ATM (Doc 4444) ICAO PANS Aerodromes (Doc 9981) European Action Plan for the Prevention of Runway Incursions V3.0 (November 2017) Runway Safety IKit (www.icao.int/safety/RunwaySafety) SKYbrary – Runway Incursion Portal (www.skybrary.aero)	

Stakeholder	**Aerodrome Operators**	
Runway Safety Priority	**Runway Excursions**	
Actions	**Action**	**Related Contributing Factor (if applicable)**
	1. All runway ends shall have a runway end safety area (RESA) as required by ICAO Annex 14 Vol I, or appropriate mitigations such as arresting systems for aircraft overruns.	**General Actions**
	2. Ensure that infrastructure restrictions such as changes to the published declared distances and runway length available are communicated in a timely and effective manner.	
	3. Ensure proper interface between the airport RST and the airport's SMS. 4. Conduct runway safety awareness campaigns that focus on local issues.	**Latent Conditions** Regulatory Oversight Safety Management
	5. Implement an enhanced global reporting format for assessing and reporting runway surface conditions as set out in the amendment to ICAO Annex 14 Vol I (applicable 2020) and ensure staff are appropriately trained on its use (ICAO training material to be published in 2018).	**Threats** Contaminated runway/taxiway Meteorology
	6. Ensure that runways, runway strips, manoeuvring areas and their associated visual aids such as signage, marking, lighting, etc. conform to ICAO Annex 14 Vol I specifications. In particular, paved runways shall be constructed or resurfaced as to provide such friction characteristics at or above the minimum friction level set by the State.	
	7. Make use of any available technologies, such as wind shear warning systems, where appropriate.	
	8. Ensure that runway conditions are reported in a timely manner.	
References	ICAO Annex 14 Vol I - Aerodromes ICAO PANS-Aerodromes (Doc 9981) ICAO Runway Safety Team Handbook Second Edition FSF Report: Go-Around Decision-Making and Execution Project FSF Report: Reducing the Risk of Runway Excursions Unstable Approaches Risk Mitigation Policies, Procedures and Best Practices European Action Plan for the Prevention of Runway Excursions Edition 1.0 EASA: European Plan for Aviation Safety (EPAS) 2017-2021 Runway Safety IKit (www.icao.int/safety/RunwaySafety) SKYbrary – Runway Excursion Portal (www.skybrary.aero)	

Stakeholder	**Aerodrome Operator**	
Runway Safety Priority	**Runway Incursions**	
Actions	**Action**	**Related Contributing Factor (if applicable)**
	1. Through the RST conduct safety risk assessments to evaluate risks posed by operational changes such as: a) the volume and density of aircraft and vehicle traffic increases significantly; b) operations in lower visibility conditions than currently permitted are planned; and c) the aerodrome layout has changed, i.e. new runways, taxiways, or aprons are brought into operation. And develop specific recommendations to reduce identified risks. 2. Conduct runway safety awareness campaigns that focus on local issues and mitigations.	**Latent conditions** Regulatory Oversight Safety Management
	3. Establish and implement a formal "maneuvering area driver training and assessment programme" and periodically review driver guidelines. Pay particular attention to the following areas: a) Improving requirements and training for driving in adverse weather conditions, particularly low visibility and driving at night. b) Reviewing Airside Vehicle Driver training programme against available best practices and guidelines. c) Ensuring that procedures for the control of all vehicles on the maneuvering area are developed and implemented in coordination with air traffic control.	**Active Human Performance** **Threats** Meteorology
	4. Co-ordinate and ensure implementation of Low Visibility procedures.	
	5. Through the RST identify local runway incursion "Hot Spots" through investigation reports and other suitable data and take actions as follows: a) Publish charts showing hot spots and ensure they are checked regularly for accuracy, revised as needed, distributed locally, and published in the AIP. b) Employ suitable strategies to remove or mitigate hazards associated with identified "Hot Spots" at the earliest opportunity.	**Aerodrome Design** **Active Human Performance**
	6. Consider implementing available technologies such as A-SMGCS and Autonomous Runway Incursion Warning System (e.g. runway status lights).	

	7. Ensure that any new infrastructure or changes to existing infrastructure take runway incursion risks and their mitigations into consideration. Make use of available best practices and guidance materials. 8. Ensure that any planned works undergoes a safety assessment by the aerodrome RST and SMS to identify any risks and take appropriate mitigation actions. Ensure all relevant stakeholders (ANSPs, Operators etc.) are properly informed of any planned works in advance, including the results of the risk analysis. 9. Ensure that any signs with the potential for confusion during works in progress are properly concealed.	
References	ICAO Annex 14 Vol I – Aerodromes ICAO Aerodrome Design Manual (Doc 9157) ICAO PANS Aerodromes (Doc 9981) ICAO Manual on the Prevention of Runway Incursions (Doc 9870) ICAO Runway Safety Team Handbook Second Edition European Action Plan for the Prevention of Runway Incursions V3.0 (November 2017) Runway Safety IKit (www.icao.int/safety/RunwaySafety) SKYbrary – Runway Incursion Portal (www.skybrary.aero)	

<table>
<tr><td>Stakeholder</td><td colspan="2">Aircraft Manufacturers</td></tr>
<tr><td>Runway Safety Priority</td><td colspan="2">Runway Excursions</td></tr>
<tr><td rowspan="4">Actions</td><td>Action</td><td>Related Contributing Factor (if applicable)</td></tr>
<tr><td>1. Manufacturers should monitor and analyse all runway excursions worldwide for the aircraft they produce and share the lessons learned with operators and other stakeholders.

2. Continue development of runway overrun awareness and alerting systems.</td><td>General Actions</td></tr>
<tr><td>3. Work with operators to improve SOP guidance based on operational experience.

4. Train for effective use of new technology to determine landing distance in all weather conditions.</td><td>Latent Conditions
Flight Ops: SOPs
Flight Ops: Training</td></tr>
<tr><td>5. Continue development of stable approach and energy management monitoring and alerting systems.

6. Provide SOP guidance with clear limits and actions to be taken following an approach deviation.</td><td>Active Human Performance
Failure to Go-Around after Destabilized Approach
Manual Handling / Flight Controls</td></tr>
<tr><td>References</td><td colspan="2">FSF Report: Go-Around Decision-Making and Execution Project
FSF Report: Reducing the Risk of Runway Excursions
IATA/IFALPA/IFATCA/CANSO Unstable Approaches Risk Mitigation Policies, Procedures and Best Practices
European Action Plan for the Prevention of Runway Excursions Edition 1.0
EASA: European Plan for Aviation Safety (EPAS) 2017-2021
Runway Safety IKit (www.icao.int/safety/RunwaySafety)
SKYbrary – Runway Excursion Portal (www.skybrary.aero)</td></tr>
</table>

Stakeholder	**Aircraft Manufacturers**	
Runway Safety Priority	**Runway Incursions**	
Actions	**Action**	**Related Contributing Factor (if applicable)**
	1. Develop/improve and make available pilot visual aid enhancement technologies such as improved resolution airport moving maps, enhanced vision systems and Head up Displays (HUD).	**Active Human Performance** **Threats** Meteorology
References	European Action Plan for the Prevention of Runway Incursions V3.0 (November 2017) EASA: European Plan for Aviation Safety (EPAS) 2017-2021 Runway Safety IKit (www.icao.int/safety/RunwaySafety) SKYbrary – Runway Incursion Portal (www.skybrary.aero)	

Appendix 1 – ICAO Runway Safety Accident Category Definitions (As per CICTT Aviation Occurrence Categories)

Category	Description
Abnormal Runway Contact (ARC)	Any landing or take-off involving abnormal runway or landing surface contact.
Bird Strike (Bird)	A collision / near collision with or ingestion of one or several birds.
Ground Collision (GCOL)	Collision while taxiing to or from a runway in use.
Ground Handling (RAMP)	Occurrences during (or as a result of) ground handling operations.
Runway Excursion (RE)	An event in which an aircraft veers off or overruns off the runway surface during either take-off or landing.
Runway Incursion (RI)	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.
Loss of Control on the Ground (LOC-G)	Loss of aircraft control while the aircraft is on the ground.
Collision with Obstacle(s) (CTOL)	Collision with obstacle(s), during take-off or landing whilst airborne.
Undershoot / Overshoot (USOS)	A touchdown off the runway surface.
Aerodrome (ADRM)	Occurrences involving aerodrome design, service, or functionality issues.

CICTT Aviation Occurrence Categories may be found at www.intlaviationstandards.org

Appendix 2 – Runway Safety Accident and Serious Incident Statistics

The Runway Safety Programme's Runway Safety Action Plan Working Group (RSAP-WG) conducted a review of available accident and serious incident data and conducted a risk assessment in order to identify runway safety priorities and to prioritize runway safety improvement initiatives.

The RSAP-WG reviewed air transport accident and serious incident data from 2008 to 2016 for aircraft with a maximum take-off weight (MTOW) greater than 5700 kg. Events related to runway safety include the following ICAO accident occurrence categories:

- Abnormal Runway Contact
- Bird Strike
- Ground Collision
- Ground Handling
- Runway Excursion
- Runway Incursion
- Loss of Control on the Ground
- Collision with Obstacle(s)
- Undershoot / Overshoot
- Aerodrome

The definition of each accident category may be found in Appendix 1.

Figure 1 below shows the trend of runway safety accidents and serious incidents for the period 2008-2016 while Figure 2 shows the number of fatal accidents within that same period. The number of runway safety related accidents remains high, although the majority of the accidents are survivable with only 4 per cent of reported occurrences resulting in a fatal accident.

Figure 1: Total Runway Safety Accidents / Serious Incidents 2008-2016 (ICAO ADREP Data)

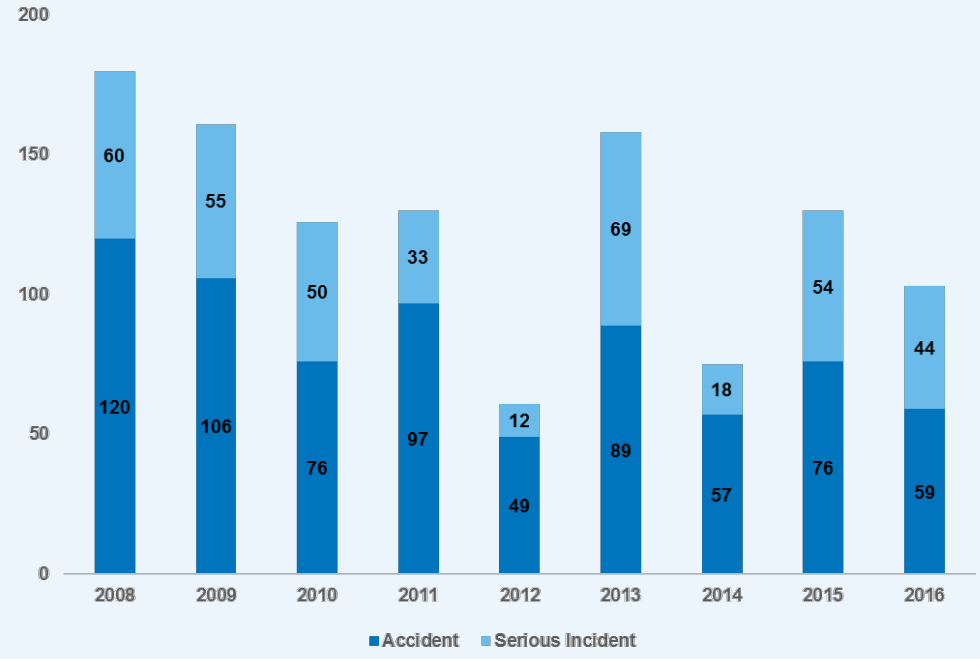


Figure 2: Number of runway safety fatal accidents per year 2008-2016 (ICAO ADREP Data)

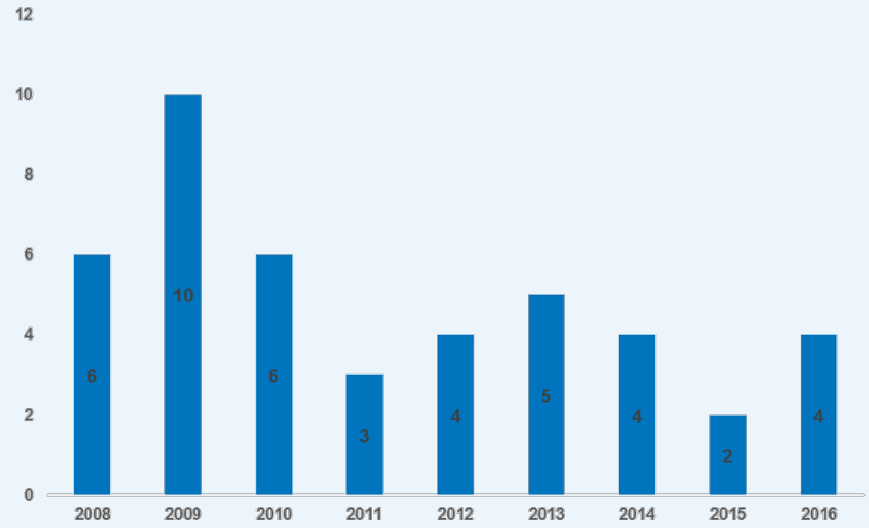
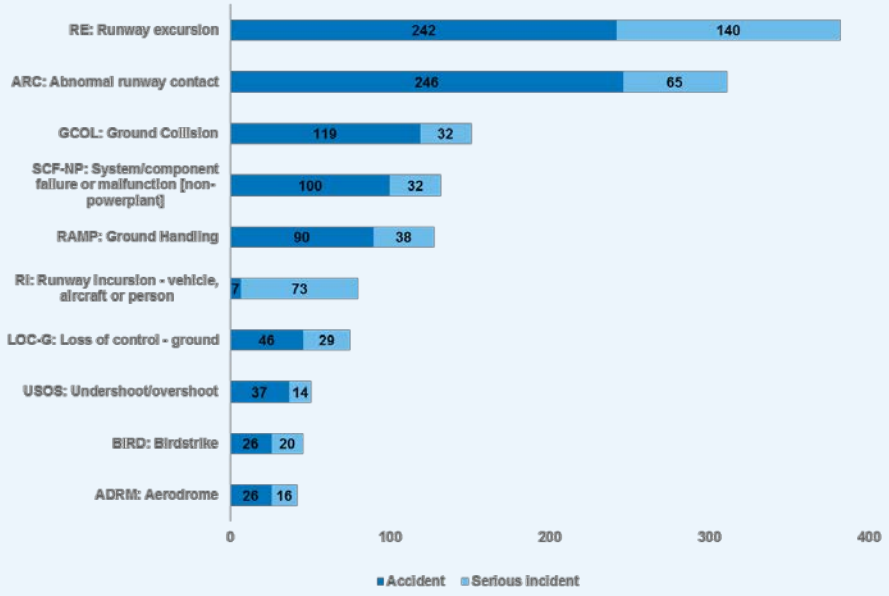


Figure 3 below shows the breakdown of runway safety accidents and serious incidents by occurrence category. Runway excursion was the top category with 34 per cent of reports. The next two highest occurrence categories reported were abnormal runway contact and ground collision, with 28 per cent and 14 per cent of reports respectively. The top three categories accounted for 76 per cent of the runway safety accidents and serious incidents during the reporting period.

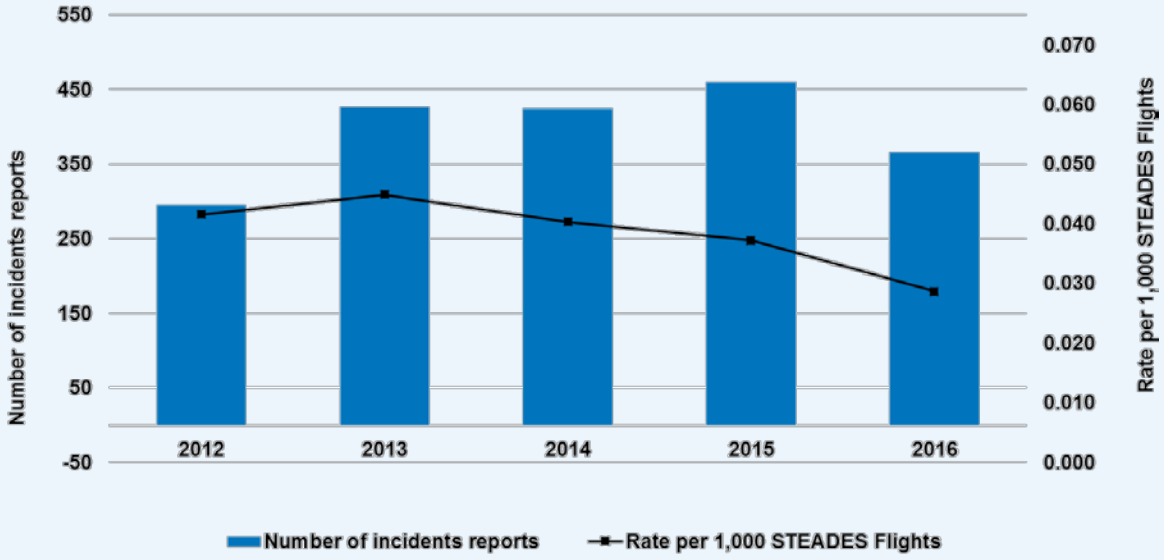
Figure 3: Runway Safety Accidents / Serious Incidents by Occurrence Category 2008-2016 (ICAO ADREP Data)



Runway Incursions

Although the runway incursion accidents reported between the period of 2008 to 2016 is very low, the number of runway incursion incidents remains high. An analysis by IATA of runway incursion incidents reported in their STEADES database shows that on average there is a runway incursion event reported in STEADES every day, with a total of 1,971 reports from 2012-2016. Figure 6 below shows the yearly distribution of runway incursion reported incidents from 2012 to 2016.

Figure 4: Runway incursion incidents yearly distribution 2012-2016 (IATA STEADES)



Runway Safety Risk Index

The RSAP-WG conducted a safety risk assessment of the runway safety occurrence categories to confirm runway safety risk priorities and to identify appropriate mitigation measures.

A runway safety risk index methodology developed by the FAA was used to assess the risk and severity of the runway safety occurrence categories. The risk index methodology uses modelling to assign risk weights to the outcomes of an event such as fatalities, injuries, aircraft damage, and each type of runway occurrence. The weights are based on "proximities" to fatalities and gives "credit" for saving lives and minimally-damaged aircraft.

Figure 7 below shows the normalized cumulative weight and the number of incidents from 2008 to 2016, while Table 1 shows the total risk weight and average risk weight per runway safety related occurrence category. Runway excursions has the highest risk category with a total risk weight significantly higher than all other categories.

Figure 5: Total runway safety events and cumulative risk weight, 2008-2016 (ICAO ADREP Data)

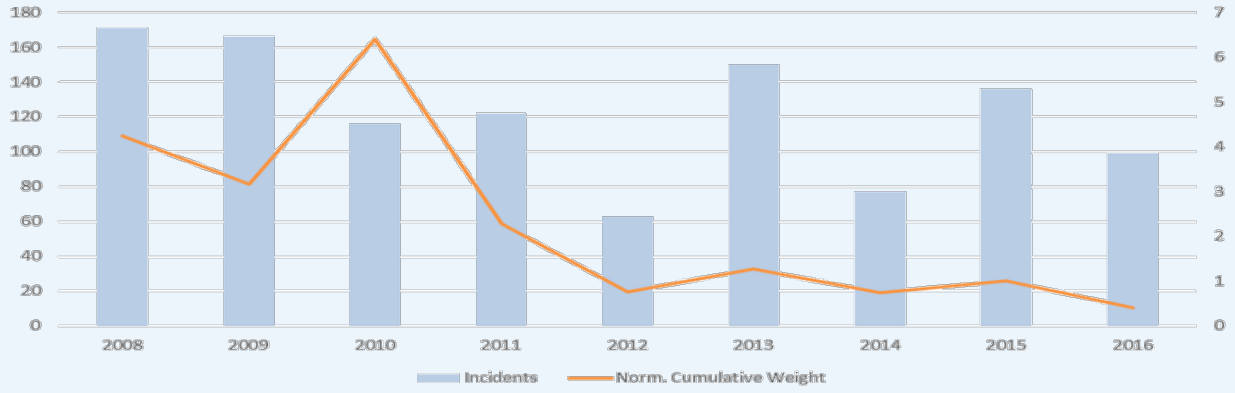


Table 1: Total risk weight and average risk weight per runway safety occurrence category

Incident Type	Total Risk Weight	Average Risk Weight
RE: Runway excursion	390.7	0.96
GCOL: Ground Collision	64.7	0.43
ARC: Abnormal runway contact	60.7	0.19
USOS: Undershoot/overshoot	57.7	1.13
CTOL: Collision with obstacle(s) during take-off and landing	32.9	1.49
LOC-G: Loss of control - ground	9.8	0.13
RI: Runway incursion - vehicle, aircraft or person	0.87	0.01

Appendix 3 – References

- EASA European Plan for Aviation Safety (EPAS) 2017-2021
- EUROCONTROL Study: Runway Incursion Incidents in Europe - Safety Functions Maps analysis of 2013 - 2015 data sample
- EUROCONTROL Study: Runway Incursion Serious Incidents & Accidents - SAFMAP analysis of 2006 - 2016 data sample
- European Action Plan for the Prevention of Runway Excursions Edition 1.0
- European Action Plan for the Prevention of Runway Incursions V3.0 (November 2017)
- FAA National Runway Safety Plan 2015-2017
- FAA Runway Incursion Safety Issue - Safety Risk Management Document
- FAA Runway Safety Metric Weighting Scheme
- FAA Runway Safety Report 2013-2014
- Flight Safety Foundation's Go-Around Decision-Making and Execution Project – March 2017
- Flight Safety Foundation's report on Reducing the Risk of Runway Excursions – May 2009
- IATA/IFALPA/IFATCA/CANSO Unstable Approaches Risk Mitigation Policies, Procedures and Best Practices
- IATA Annual Safety Report – 2016, Addendum A: Top Contributing Factors – Section 4
- ICAO Annex 1 – Personnel Licensing
- ICAO Annex 14 – Aerodromes
- ICAO Annex 19 – Safety Management
- ICAO Global Aviation Safety Plan 2017 – 2019 (Doc 10004)
- ICAO Manual on the Prevention of Runway Incursions (Doc 9870)
- ICAO PANS-Aerodromes (Doc 9981)
- ICAO Circular 329 - Assessment, Measurement and Reporting of Runway Surface Conditions
- ICAO Safety Management Manual (Doc 9859)
- ICAO Runway Safety Team Handbook Edition 2.0
- ICAO Safety Report 2017 Edition