Annex A: Safety data collection for RMT.0296 - Review of aeroplane performance requirements for CAT operations

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Introduction

The general objective of the RMT.0296 is to provide a uniform, cost-efficient rules and safety standards on aeroplane performance requirements for Commercial Air Transport operations. The specific objective is to reduce the number of accidents and serious incidents where aeroplane performance is a causal factor. Secondly, the resulting amendments should provide improved clarity, technical accuracy, flexibility or a combination of these benefits for the EU operational requirements on aeroplane performance for CAT operations. Thirdly, one of the aims of RMT.0296 is to contribute to the harmonisation of FAA and EU operational requirements on aeroplane performance for CAT operations.

During the development of the draft rules and the Regulatory Impact Assessment (RIA), the Rule Making Group reviews the Take-off and Landing Performance Assessment Advisory and Rulemaking Committee (TALPA ARC) recommendations and their endorsement in the European Action Plan for the Prevention of Runway Excursions (EAPPRE). The latter document, while recognising runway excursions as a recurring cause of accidents and serious incidents and identifying the main casual factors, contain recommendations to EASA, which are going to be addressed by the RMT.0296.

Objectives

Taking into account the principles mentioned above, as a part of the Analysis of Runway Excursions (RE) 2011-2015 and basing on the same set of occurrences, a sub-study has been performed in order to indicate all accidents and serious incidents in which at least one of the following conditions was fulfilled:

— Aeroplane performance calculation was inadequate to the reported runway condition,
— Measurement and/or reporting of the runway condition was inaccurate,
— Runway condition was a casual factor of an occurrence.

The results of this study will contribute to the safety data collection for the RIA.

Scope

The set of study is composed of 13 occurrences, each of them involving one aircraft. All accidents and serious incidents occurred in the period of 5 years between 01/01/2011 and 31/12/2015. Figure 1 summarises the distribution of occurrences along this period and its split between accident and serious incident (ICAO Annex 13 definitions). Due to the ongoing investigation of accidents and serious incidents, the true figure is possible to be slightly higher as complete investigations are not yet available for all events happened in 2015.

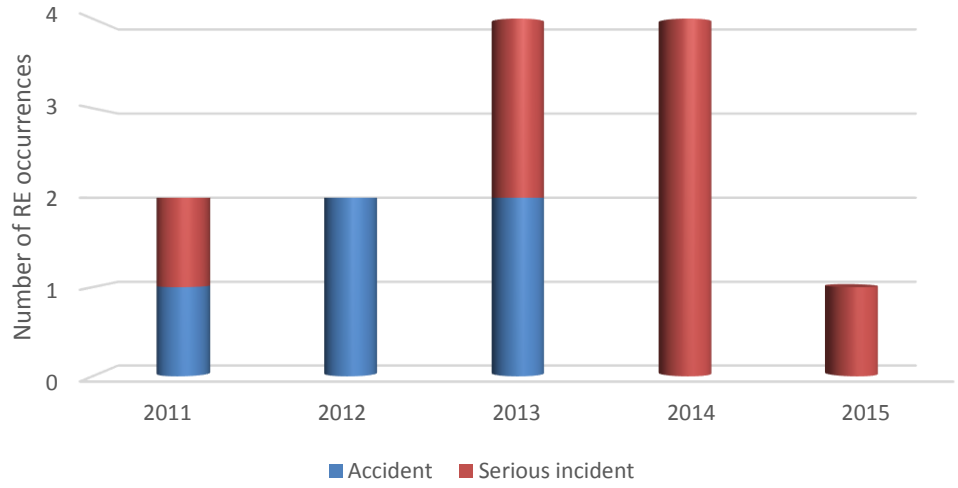

Figure 1. Distribution by year and class of the occurrence

There are 11 different States of Registry represented in the study set: Bulgaria, Czech Republic, Denmark, Estonia, Germany, Greece, Morocco, Norway, Romania, Sweden and United Kingdom (see Figure 2). States of the operator are the same as the states of registry for all aircraft except one, which was registered in Norway and operated by a Swedish operator.

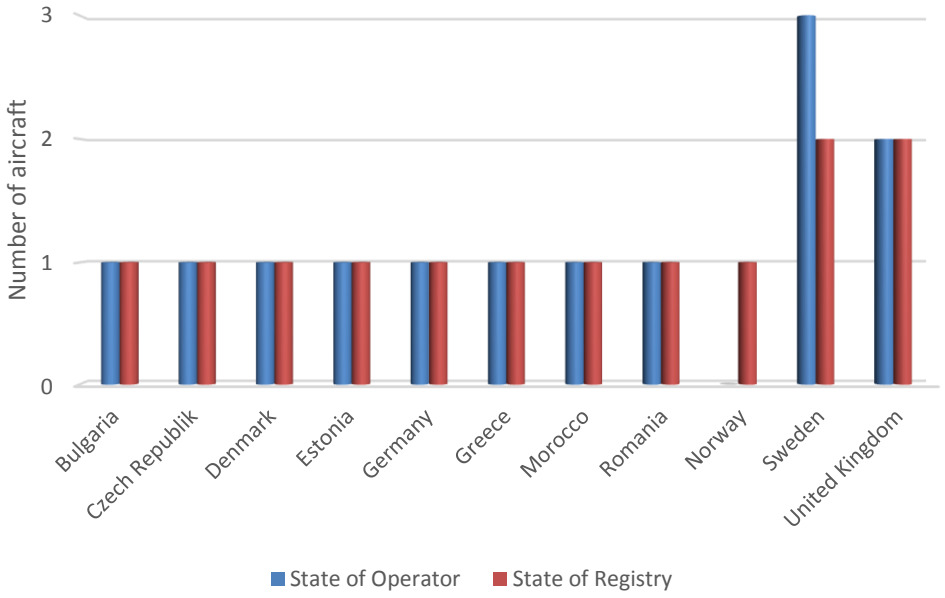

Figure 2. Distribution by state of operator and state of registry

As shown in Figure 3, the vast majority of occurrences happened during landing, with 5 of them classified as accidents and 9 as serious incidents.

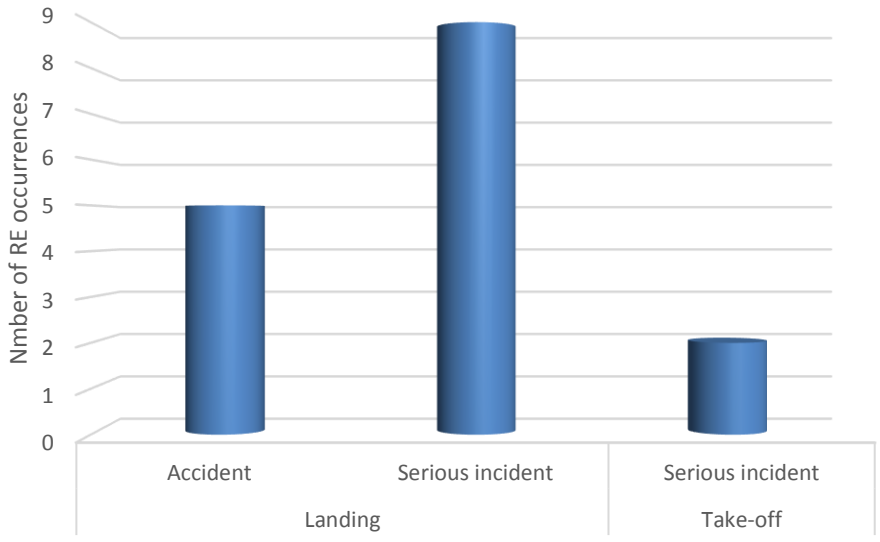

Figure 3. Distribution by phase of flight and occurrence class

From the Figure 4 it is clear that runway overruns were less frequent, however they caused higher level of damages and/or injuries than runway side excursions.

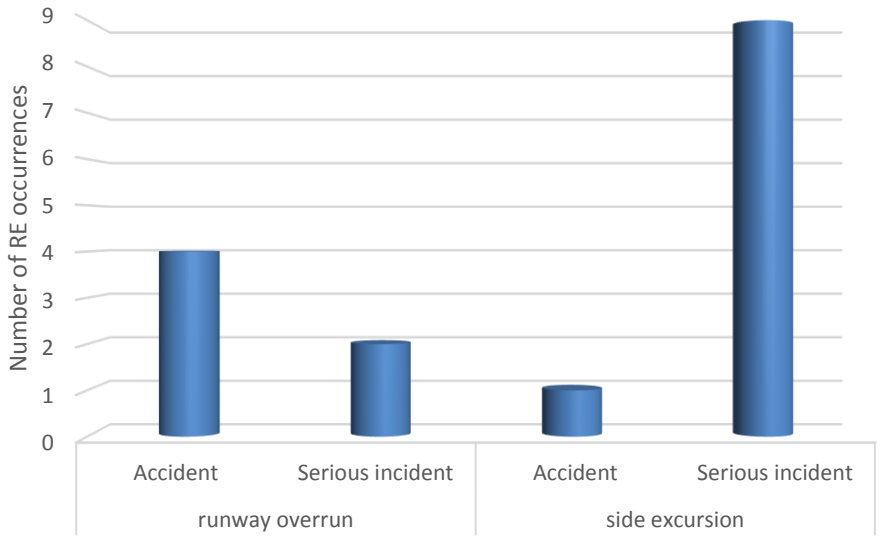

Figure 4. Distribution by type of runway excursion and occurrence class

Figure 5 depicts the number of occurrences with a distinction between types of runway excursion, as well as between those that happened on landing and those that happened during take-off. The number of runway overruns and side excursions occurred during landing is balanced. In the study set there was no instance of a runway overrun during take-off.

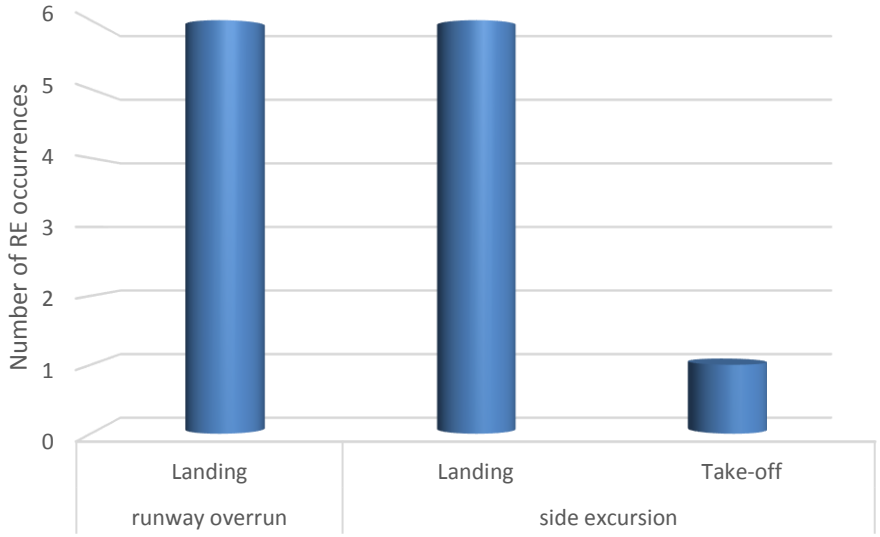

Figure 5. Distribution by type of runway excursion and phase of flight

Figure 6 presents the distribution by propulsion type depending on the aircraft mass group. Among the aircraft lighter than 5 700 kg all were equipped with reciprocating engines, while the heavier aircraft have turbofan or turboprop engines.

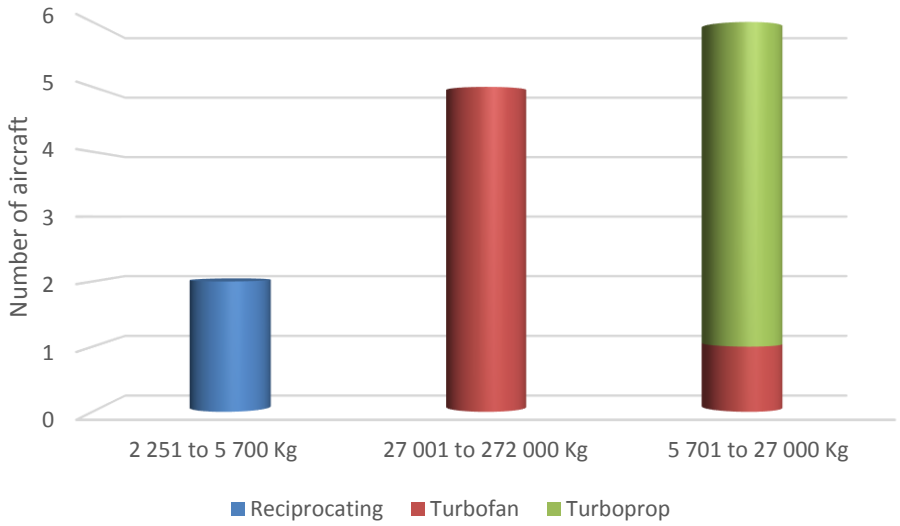

Figure 6. Distribution by aircraft mass and propulsion type

There are 9 manufactures and 11 different models of aircraft represented in the study set (see Figure 7).

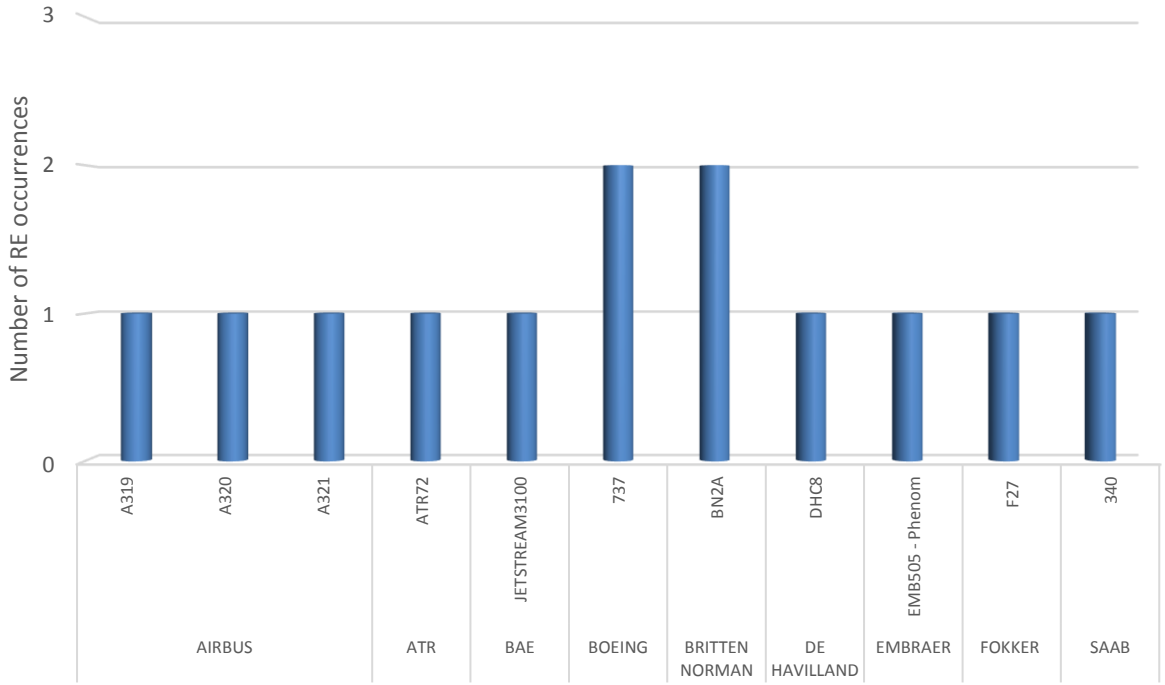

Figure 7. Distribution by manufacturer and model of the aircraft

Due to specific criteria of selection (described in section 'Objectives'above) and a small size of sample of occurrences, none of the graphs presented above should be considered statistically representative for all runway excursion accidents and serious incidents occurred in the EASA MS or involving EASA MS operators.

Occurrences description tables

Performance calculation

Occurrence 1 of 5		Performance calculation			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
31/01/2014	Sweden	Aeroplane	BAE - JETSTREAM3100 - 3200		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turboprop	Serious incident	Landing	side excursion
The take-off was delayed due to prevailing weather with heavy snowfall. On board were 15 passengers and two crew members. The weather forecasts for the current flight sector contained warnings of severe icing. The aircraft's propeller de-icing system for the right engine was out of order, which was known by the commander. The malfunction was not noted in the aircraft logbook. At the airport snow clearing was in progress due to the weather with 2 000 meters visibility in snowfall. In the final phase of the clearing the friction coefficients were measured (see Section 1.6.9) on the runway and reported to the arriving aircraft. The measured coefficients - which corresponded to medium braking action - did not cause any action by the pilots as corrections for this was not included in the operator's performance data. The aircraft initiated a manual approach to runway 16 with the co-pilot at the controls. The landing took place well into the runway with about 800 meters remaining runway length. After touchdown the commander took over control of the airplane and started braking. The aircraft was unable to stop before the runway end and the commander then decided to try to steer off to the right onto the taxiway. This was not successful, and the aircraft ran out into the snow in the angle between the runway and the taxiway. No one was injured during the incident.					
main factor	snowfall, unstabilised approach, landing fast, lack of coherent operator's concept for stabilised approach				
information related to performance calculation	no use of friction coefficients, landing performed without access to any relevant performance data for landing on contaminated RWYs				

Occurrence 2 of 5		Performance calculation			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
25/08/2013	Czech Republic	Aeroplane	BOEING - 737 - 800		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	27 001 to 272 000 Kg	Turbofan	Serious incident	Landing	runway overrun
On 25. 8. 2013 during the landing, the aircraft ran outside the paved surface of the runway. The plane stopped 156 m in the foreground of the runway 27. The passengers and crew disembarked the plane with no injury. The aircraft did not suffer significant damages.					
main factor	RWY wet, wrong setting of flaps, wrong selection of braking mode, opposite direction of the runway was more favourable, incompliance with SOPs				
information related to performance calculation	wrong calculation, required distance exceeded the LDA				

Occurrence 3 of 5		Performance calculation			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
24/05/2013	Bulgaria	Aeroplane	AIRBUS - A320 - 200		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	27 001 to 272 000 Kg	Turbofan	Accident	Landing	runway overrun

Aircraft landed on runway 09 at 10:19L (07:19Z) but overran the end of the runway, broke through the localizer antenna and came to a stop about 270 meters past the runway end after colliding with the airport perimeter fence. The aircraft was evacuated.

The aircraft was approaching in poor meteorological conditions that quickly deteriorated further with rain and variable winds with significant gusts. The landing was long, the touchdown occurred a considerable distance past the touch down zone of runway 09, the aircraft ran past the end of runway 09, collided with the airport perimeter fence and came to a stop 270 meters past the end of the runway and 30 meters north of the extended runway center line. Two passengers received broken legs during the evacuation.

main factor	adverse weather conditions (wind, rain), unstabilised approach, landing long
information related to performance calculation	inadequate in depth analysis of meteorological conditions

Occurrence 4 of 5		Performance calculation			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
29/03/2013	France	Aeroplane	AIRBUS - A321 - 100		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	27 001 to 272 000 Kg	Turbofan	Accident	Landing	runway overrun

The crew made a Category 1 (CAT I) ILS approach to runway 36R. The meteorological conditions were such that low visibility procedures (LVP) were in place. On passing the stabilisation height at 1,000 ft, the speed of the aeroplane was 57 kt above the approach speed. At 140 ft, an inappropriate increase in thrust by the autothrust maintained the aeroplane at high speed. The flare was long and the aeroplane touched the runway at 1,600 metres past the 36R threshold. The aeroplane overran the runway and came to rest approximately 300 metres after the opposite threshold.

main factor	unstabilised approach (incomplete preparation for the approach – crew not aware of tailwind and wet runway), tailwind, ATC procedures not followed, partial application of SOPs, impaired task sharing and degraded CRM, progressive deterioration in situational awareness, landing fast and deep, A/THR anomaly (maintaining the aircraft at a high energy level during landing)
information related to performance calculation	wet runway, aircraft maximum landing weight and tailwind on ground not included in the calculation

Occurrence 5 of 5		Performance calculation			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**

06/08/2012	Switzerland	Aeroplane	EMBRAER (EMB505 - Phenom 300)		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turbofan	Accident	Landing	runway overrun

After the initial call to the aerodrome control centre tower, the crew quickly decided, after an enquiry from the air traffic controller, on a direct approach on the runway 10 instrument landing system (ILS). Shortly thereafter, the landing gear and flaps were extended. The flaps jammed at approximately 10 degrees and the FLAP FAIL warning message was displayed. The crew carried out a go-around shortly before landing. The landing gear subsequently remained extended. The flaps remained jammed for the remainder of the flight.

The crew decided immediately on a second ILS approach with jammed flaps, which according to the manufacturer's information required an increased approach speed. During the approach, the crew had difficulty in reducing the airspeed to this increased approach speed. At 13:40 UTC, the aircraft subsequently touched down on the wet runway at an indicated air speed of 136 kt, approximately 290 m after the runway threshold, and could not be brought to a standstill on the remaining length of runway. The aircraft then rolled over the end of runway 10, broke through the aerodrome perimeter fence and overrun the road running perpendicular to the runway centreline, on which a public transport bus was travelling. The aircraft rolled very close behind the bus and came to a standstill in a maize field, approximately 30 m from the end of the runway.

The passenger and the two pilots were not injured in the accident. The aircraft was badly damaged.
There was crop damage and damage to the aerodrome perimeter fence.

main factor	landing long and fast, unstabilised approach, flaps jammed, late initiation of braking, lack of cooperation between pilots
information related to performance calculation	aircraft configuration, approach speed, runway condition and runway length were not addressed

Runway condition as a casual factor of an occurrence

Occurrence 1 of 13		**Runway condition as a casual factor**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
25/05/2015	Oslo	Aeroplane	BOEING - 737 - 800		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	27 001 to 272 000 Kg	Turbofan	Serious incident	Landing	runway overrun

Runway renovation had been in progress the last months with displaced threshold and a LDA of 1928 meters. XXRASH over the field. Another B737 who landed in front reported extremely slippery concrete on the rwy. B737 landed with flaps 30, autobrake 3 and touchdown 3-400 meters down the rwy. Reverse power selected early but with less retardation than expected. Maximum manual braking and maximum reverse applied. Runway excursion 50-100 meters into the 300 meters safety area. Minor damage to left cowling. A couple of rwy end lights damaged. Crew were mentally prepared for landing in headwind, but actually it was approximately 7 kt tailwind. Landing calculations after the incident

shows that with autobrake 3 until complete stop, landing distance should be 1 960 meters and with manual braking 1 524 meters.	
main factor	tailwind
information related to runway condition	possible aggravating factor, extremely slippery RWY (reported by the crew of previous A/C)

Occurrence 2 of 13		**Runway condition as a casual factor**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
29/12/2014	Denmark	Aeroplane	DE HAVILLAND - DHC8 - 200		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turboprop	Serious incident	Landing	side excursion

Upon landing on runway 23 and shortly after having selected reverse on both engines, the flight crew experienced that the aircraft unexpectedly started to veer to the left. The pilot flying attempted to correct this by deactivating reverse on both engines and by use of the wheel brakes and the nose wheel steering, but the aircraft continued veering towards the left side of the runway. The aircraft ran off the left side of the runway and came to a complete stop in the safety zone. A momentary failure of the right hand power lever micro switch causing a momentary activation of the right hand propeller beta backup protection in combination with a divergence between reported and effective braking action coefficients on runway 23 had a negative effect on the flight crew's ability to maintain directional control, which resulted in the aircraft running off the side of the runway. Neither passengers nor crew members suffered any injuries.

main factor	continuous snowfall, momentary activation of right propeller beta protection, actual braking action coefficients different than reported
information related to runway condition	possible aggravating factor

Occurrence 3 of 13		**Runway condition as a casual factor**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
31/01/2014	Sweden	Aeroplane	BAE - JETSTREAM3100 - 3200		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turboprop	Serious incident	Landing	side excursion

The take-off was delayed due to prevailing weather with heavy snowfall. On board were 15 passengers and two crew members. The weather forecasts for the current flight sector contained warnings of severe icing. The aircraft's propeller de-icing system for the right engine was out of order, which was known by the commander. The malfunction was not noted in the aircraft logbook. At the airport snow clearing was in progress due to the weather with 2 000 meters visibility in snowfall. In the final phase of the clearing the friction coefficients were measured (see Section 1.6.9) on the runway and reported to the arriving aircraft. The measured coefficients - which corresponded to medium braking action - did not cause any action by the pilots as corrections for this was not included in the operator's performance data.

The aircraft initiated a manual approach to runway 16 with the co-pilot at the controls. The landing took place well into the runway with about 800 meters remaining runway length. After touchdown the commander took over control of the airplane and started braking. The aircraft was unable to stop before the runway end and the commander then

decided to try to steer off to the right onto the taxiway. This was not successful, and the aircraft ran out into the snow in the angle between the runway and the taxiway. No one was injured during the incident.	
main factor	snowfall, unstabilised approach, landing fast, lack of coherent operator's concept for stabilised approach
information related to runway condition	RWY contaminated with snow

Occurrence 4 of 13		**Runway condition as a casual factor**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
12/01/2014	United Kingdom	Aeroplane	BRITTEN NORMAN - BN2A - III2		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	2 251 to 5 700 Kg	Reciprocating	Serious incident	Landing	side excursion

Runway excursion in crosswind caused damage to runway edge lights.

During a landing in heavy rain and with a strong crosswind the aircraft was blown from the asphalt runway surface onto the grass edge of the runway, damaging three runway lights. The aircraft was undamaged.

The aircraft was making an approach into destination Airport. The pilot stated that, during the latter stages of the approach, there was a strong, gusting southerly crosswind and that the rain suddenly intensified. The pilot also stated that, during the landing roll, a very strong gust of wind was felt from the left such that the right main landing gear lost grip in a large area of standing water. The aircraft veered to the right, off the asphalt surface and onto the grass area at the side of the runway. The pilot was able to steer it back onto the asphalt section of the runway. The aircraft was undamaged but ATC subsequently discovered that the right main wheels had run over and damaged three runway edge lights.

The aircraft encountered heavy rain shortly before touchdown and a strong crosswind gust shortly after touchdown. The strong gust and loss of the main landing gear grip in standing water caused the aircraft to veer to the right, off the asphalt surface and onto the grass area to the side of the runway.

As a result of this incident, the operator reviewed its operation into the destination airport and reduced the crosswind limit for its Trislander aircraft to 20 kt while the runway declared width is reduced.

main factor	emergency descent, crosswind, human factor (crew fatigue)
information related to runway condition	loss of MLG grip in standing water on RWY

Occurrence 5 of 13		**Runway condition as a casual factor**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
10/01/2014	Sweden	Aeroplane	FOKKER - F27 - 50		

Operator	Mass group	Propulsion type	Occurrence class	Flight phase	Type of RE
	5 701 to 27 000 Kg	Turboprop	Serious incident	Landing	side excursion

The weather forecast for destination Airport that had been issued at 18.30 hrs stated the wind direction to be 280 degrees and the wind strength 25 knots with wind gusts of 45 knots as well as temporary rain showers. The corresponding forecast that was issued at 00.30 hrs, i.e. about 45 minutes after take-off, stated the wind direction to be 280 degrees and the wind strength 30 knots with wind gusts of 42 knots as well as temporary rain showers. The forecasted wind direction meant that the wind was largely across the runway, i.e. direct crosswind.

The operator's flight manual stated a limitation, regarding the crosswind component on landing, of 30 knots for a dry runway and 25 knots for a wet runway. According to the manufacturer's flight manual, the corresponding limitation is 33 knots for good braking action.

According to the crew, the approach and touchdown were performed without problems. Shortly after touchdown, the engines were reversed. When the speed reduced, the aircraft began to yaw to the left. The commander explained that he used the nose wheel steering to compensate the yawing tendency but that the nose wheel “probably went across”. Furthermore, he was unsure whether the brakes had been used.

The yaw continued towards the left, and the aircraft left the runway and stopped with the nose wheel and left main gear in the grass, with the right main gear on the asphalted runway shoulder. In connection with the excursion, the nose gear and left main gear each ploughed a furrow in the ground on the grass area with a depth corresponding to just under half the diameter of the wheels.

main factor	operator’s crosswind limitations of the aircraft exceeded, wet runway, one alternate only
information related to runway condition	wet RWY, but braking action good

Occurrence 6 of 13		Runway condition as a casual factor			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
18/12/2013	United Kingdom	Aeroplane	AIRBUS - A319 - 100		
	Mass group	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	27 001 to 272 000 Kg	Turbofan	Serious incident	Landing	side excursion

Lateral runway excursion. The Aircraft slewed sideways on landing at approximately 70 knots. The LH gear exited the runway. Mud covered the LH landing gear and the Engine 1 cowlings and L/H fuselage. Initial inspections show no damage.

main factor	strong crosswind (close to or possibly above maximum aircraft limitation), insufficient de-crab at landing, no use of differential braking on a wet/flooded RWY
information related to runway condition	possible aggravating factor, RWY between wet and flooded condition

Occurrence 7 of 13	Runway condition as a casual factor

Local date	State/area of occurrence	Aircraft category	Manufacturer/model	Aircraft registration	State of registry
25/08/2013	Czech Republic	Aeroplane	BOEING - 737 - 800		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	27 001 to 272 000 Kg	Turbofan	Serious incident	Landing	overrun
On 25. 8. 2013 during the landing, the aircraft ran outside the paved surface of the runway. The plane stopped 156 m in the foreground of the runway 27. The passengers and crew disembarked the plane with no injury. The aircraft did not suffer significant damages.					
main factor	RWY wet, wrong setting of flaps, wrong selection of braking mode, opposite direction of the runway was more favourable, incompliance with SOPs				
information related to runway condition	wet RWY as a possible aggravating factor				

Occurrence 8 of 13		Runway condition as a casual factor			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
24/05/2013	Bulgaria	Aeroplane	AIRBUS - A320 - 200		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	27 001 to 272 000 Kg	Turbofan	Accident	Landing	runway overrun
Aircraft landed on runway 09 at 10:19L (07:19Z) but overran the end of the runway, broke through the localizer antenna and came to a stop about 270 meters past the runway end after colliding with the airport perimeter fence. The aircraft was evacuated. The aircraft was approaching to the destination airport in poor meteorological conditions that quickly deteriorated further with rain and variable winds with significant gusts. The landing was long, the touchdown occurred a considerable distance past the touch down zone of runway 09, the aircraft ran past the end of runway 09, collided with the airport perimeter fence and came to a stop 270 meters past the end of the runway and 30 meters north of the extended runway center line. Two passengers received broken legs during the evacuation.					
main factor	adverse weather conditions (wind, rain), unstabilised approach, landing long				
information related to runway condition	wet, but braking action good				

Occurrence 9 of 13		Runway condition as a casual factor			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
29/03/2013	France	Aeroplane	AIRBUS - A321 - 100		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**

	27 001 to 272 000 Kg	Turbofan	Accident	Landing	runway overrun
The crew made a Category 1 (CAT I) ILS approach to runway 36R. The meteorological conditions were such that low visibility procedures (LVP) were in place. On passing the stabilisation height at 1,000 ft, the speed of the aeroplane was 57 kt above the approach speed. At 140 ft, an inappropriate increase in thrust by the autothrust maintained the aeroplane at high speed. The flare was long and the aeroplane touched the runway at 1,600 metres past the 36R threshold. The aeroplane overran the runway and came to rest approximately 300 metres after the opposite threshold.					
main factor	unstabilised approach (incomplete preparation for the approach – crew not aware of tailwind and wet runway), tailwind, ATC procedures not followed, partial application of SOPs, impaired task sharing and degraded CRM, progressive deterioration in situational awareness, landing fast and deep, A/THR anomaly (maintaining the aircraft at a high energy level during landing)				
information related to runway condition	wet RWY				

Occurrence 10 of 13		**Runway condition as a casual factor**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
11/08/2012	Romania	Aeroplane	ATR - ATR72 - 200		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turboprop	Accident	Landing	side excursion
During landing roll, at about 100m from touch down, the A/C exit the runway to the left and continue to run for about 300m on unpaved surface (grass and earth), with all three landing gears, and after that returned to the runway.					
main factor	aquaplaning				
information related to runway condition	possible aggravating factor, wet runway with puddles				

Occurrence 11 of 13		**Runway condition as a casual factor**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
06/08/2012	Switzerland	Aeroplane	EMBRAER (EMB505 - Phenom 300)		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turbofan	Accident	Landing	runway overrun
After the initial call to the aerodrome control centre tower, the crew quickly decided, after an enquiry from the air traffic controller, on a direct approach on the runway 10 instrument landing system (ILS). Shortly thereafter, the landing gear and flaps were extended. The flaps jammed at approximately 10 degrees and the FLAP FAIL warning message was displayed. The crew carried out a go-around shortly before landing. The landing gear subsequently remained extended. The flaps remained jammed for the remainder of the flight. The crew decided immediately on a second ILS approach with jammed flaps, which according to the manufacturer's information required an increased approach speed. During the approach, the crew had difficulty in reducing the airspeed to this increased approach speed. At 13:40 UTC, the aircraft subsequently touched down on the wet runway					

at an indicated air speed of 136 kt, approximately 290 m after the runway threshold, and could not be brought to a standstill on the remaining length of runway. The aircraft then rolled over the end of runway 10, broke through the aerodrome perimeter fence and overrun the road running perpendicular to the runway centreline, on which a public transport bus was travelling. The aircraft rolled very close behind the bus and came to a standstill in a maize field, approximately 30 m from the end of the runway.

The passenger and the two pilots were not injured in the accident. The aircraft was badly damaged.
There was crop damage and damage to the aerodrome perimeter fence.

main factor	landing long and fast, unstabilised approach, flaps jammed, late initiation of braking, lack of cooperation between pilots
information related to runway condition	wet RWY, friction coefficient not measured

Occurrence 12 of 13		**Runway condition as a casual factor**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
24/11/2011	Sweden	Aeroplane	SAAB 340		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turboprop	Serious incident	Take-off	side excursion

Runway veer off during takeoff, flat snow covered grass, minor damage nose wheel, taxi light, propeller tip.

The take-off was performed in darkness and winter conditions. In connection with the take off a snow shower came in over the field which meant that visibility deteriorated and the wind speed increased. During take-off the aircraft gradually approached the left edge of the runway. After about 800 m the aircraft ran out of the left edge of the runway with the left main wheel and the nose wheel, continued parallel to the runway for about 350 meters and then came back up onto the runway again. Shortly thereafter, the aircraft veered once more to the left, left the runway completely and stopped a few metres from the runway edge parallel to the direction of take-off.

All persons on board were uninjured and left the aircraft through the main entrance and its staircase.

The incident was probably caused by a perceptual illusion for the pilots on account of large flakes of blowing snow, which led to the aircraft's drift not being noticed in time. The illuminated landing lights have served to reinforce the illusion.

main factor	perceptual illusion (snowfall with large flakes)
information related to runway condition	possible, RWY contaminated with snow

Occurrence 13 of 13		**Runway condition as a casual factor**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
08/06/2011	Germany	Aeroplane	BRITTEN NORMAN - BN2A		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**

	2 251 to 5 700 Kg	Reciprocating	Accident	Landing	runway overrun
Overshoot during landing - Main gear collapsed. A/C substantially damaged After landing on the wet runway 33 the aircraft departed the end of the runway, crossed a walk-way and came to a stop in a dune.					
main factor	aquaplaning				
information related to the runway condition	possible aggravating factor, contaminated runway (standing water)				

Reporting of runway condition

Occurrence 1 of 5		**Reporting of runway condition**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
29/12/2014	Denmark	Aeroplane	DE HAVILLAND - DHC8 - 200		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turboprop	Serious incident	Landing	side excursion
Upon landing on runway 23 and shortly after having selected reverse on both engines, the flight crew experienced that the aircraft unexpectedly started to veer to the left. The pilot flying attempted to correct this by deactivating reverse on both engines and by use of the wheel brakes and the nose wheel steering, but the aircraft continued veering towards the left side of the runway. The aircraft ran off the left side of the runway and came to a complete stop in the safety zone. A momentary failure of the right hand power lever micro switch causing a momentary activation of the right hand propeller beta backup protection in combination with a divergence between reported and effective braking action coefficients on runway 23 had a negative effect on the flight crew's ability to maintain directional control, which resulted in the aircraft running off the side of the runway. Neither passengers nor crew members suffered any injuries.					
main factor	continuous snowfall, momentary activation of right propeller beta protection, actual braking action coefficients different than reported				
information related to the reporting of runway condition	incorrect aerodrome measurement procedures and reporting of RWY condition				

Occurrence 2 of 5		**Reporting of runway condition**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
31/01/2014	Sweden	Aeroplane	BAE - JETSTREAM3100 - 3200		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turboprop	Serious incident	Landing	side excursion

The take-off was delayed due to prevailing weather with heavy snowfall. On board were 15 passengers and two crew members. The weather forecasts for the current flight sector contained warnings of severe icing. The aircraft's propeller de-icing system for the right engine was out of order, which was known by the commander. The malfunction was not noted in the aircraft logbook. At the airport snow clearing was in progress due to the weather with 2 000 meters visibility in snowfall. In the final phase of the clearing the friction coefficients were measured (see Section 1.6.9) on the runway and reported to the arriving aircraft. The measured coefficients - which corresponded to medium braking action - did not cause any action by the pilots as corrections for this was not included in the operator's performance data.
The aircraft initiated a manual approach to runway 16 with the co-pilot at the controls. The landing took place well into the runway with about 800 meters remaining runway length. After touchdown the commander took over control of the airplane and started braking. The aircraft was unable to stop before the runway end and the commander then decided to try to steer off to the right onto the taxiway. This was not successful, and the aircraft ran out into the snow in the angle between the runway and the taxiway. No one was injured during the incident.

main factor	snowfall, unstabilised approach, landing fast, lack of coherent operator's concept for stabilised approach
information related to the reporting of runway condition	reported, but not understood by the crew

Occurrence 3 of 5		**Reporting of runway condition**			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
10/01/2014	Sweden	Aeroplane	FOKKER - F27 - 50		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turboprop	Serious incident	Landing	side excursion

The weather forecast for destination Airport that had been issued at 18.30 hrs stated the wind direction to be 280 degrees and the wind strength 25 knots with wind gusts of 45 knots as well as temporary rain showers. The corresponding forecast that was issued at 00.30 hrs, i.e. about 45 minutes after take-off, stated the wind direction to be 280 degrees and the wind strength 30 knots with wind gusts of 42 knots as well as temporary rain showers. The forecasted wind direction meant that the wind was largely across the runway, i.e. direct crosswind.

The operator's flight manual stated a limitation, regarding the crosswind component on landing, of 30 knots for a dry runway and 25 knots for a wet runway. According to the manufacturer's flight manual, the corresponding limitation is 33 knots for good braking action.

According to the crew, the approach and touchdown were performed without problems. Shortly after touchdown, the engines were reversed. When the speed reduced, the aircraft began to yaw to the left. The commander explained that he used the nose wheel steering to compensate the yawing tendency but that the nose wheel "probably went across". Furthermore, he was unsure whether the brakes had been used.

The yaw continued towards the left, and the aircraft left the runway and stopped with the nose wheel and left main gear in the grass, with the right main gear on the asphalted runway shoulder. In connection with the excursion, the nose gear and left main gear each ploughed a furrow in the ground on the grass area with a depth corresponding to just under half the diameter of the wheels.

main factor	operator's crosswind limitations of the aircraft exceeded, wet runway, one alternate only
information related to the reporting of runway condition	ATIS not understood by the crew (disruption by other communication), the crew had no awareness of the prevailing condition that the runway

	was wet

Occurrence 4 of 5		Reporting of runway condition			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
24/05/2013	Bulgaria	Aeroplane	AIRBUS - A320 - 200		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	27 001 to 272 000 Kg	Turbofan	Accident	Landing	runway overrun

Aircraft landed on runway 09 at 10:19L (07:19Z) but overran the end of the runway, broke through the localizer antenna and came to a stop about 270 meters past the runway end after colliding with the airport perimeter fence. The aircraft was evacuated.

The aircraft was approaching destination airport in poor meteorological conditions that quickly deteriorated further with rain and variable winds with significant gusts. The landing was long, the touchdown occurred a considerable distance past the touch down zone of runway 09, the aircraft ran past the end of runway 09, collided with the airport perimeter fence and came to a stop 270 meters past the end of the runway and 30 meters north of the extended runway center line. Two passengers received broken legs during the evacuation.

main factor	adverse weather conditions (wind, rain), unstabilised approach, landing long
information related to the reporting of runway condition	misleading ATIS information 'NOSIG', TAF communicated but it didn't reach the crew

Occurrence 5 of 5		Reporting of runway condition			
Local date	**State/area of occurrence**	**Aircraft category**	**Manufacturer/model**	**Aircraft registration**	**State of registry**
24/11/2011	Sweden	Aeroplane	SAAB 340		
Operator	**Mass group**	**Propulsion type**	**Occurrence class**	**Flight phase**	**Type of RE**
	5 701 to 27 000 Kg	Turboprop	Serious incident	Take-off	side excursion

Runway veer off during takeoff, flat snow covered grass, minor damage nose wheel, taxi light, propeller tip.

The take-off was performed in darkness and winter conditions. In connection with the take off a snow shower came in over the field which meant that visibility deteriorated and the wind speed increased. During take-off the aircraft gradually approached the left edge of the runway. After about 800 m the aircraft ran out of the left edge of the runway with the left main wheel and the nose wheel, continued parallel to the runway for about 350 meters and then came back up onto the runway again. Shortly thereafter, the aircraft veered once more to the left, left the runway completely and stopped a few metres from the runway edge parallel to the direction of take-off.

All persons on board were uninjured and left the aircraft through the main entrance and its staircase.

The incident was probably caused by a perceptual illusion for the pilots on account of large flakes of blowing snow, which led to the aircraft's drift not being noticed in time. The illuminated landing lights have served to reinforce the illusion.

main factor	perceptual illusion (snowfall with large flakes)

information related to the reporting of runway condition	reported runway condition were not reflecting the actual condition