



**Practical implementation steps before
application
of the Runway Condition Report**

Facts about Norwegian



- **World's 7th largest low-cost carrier**
- **Third largest low-cost carrier in Europe**
- **5 500 employees**
- **17 operational bases:** The company currently has 17 operational bases: London (UK), Malaga (Spain), Las Palmas (Spain), Alicante (Spain), Tenerife (Spain), Barcelona (Spain), Madrid (Spain), Oslo (Norway), Bergen (Norway), Trondheim (Norway), Stavanger (Norway), Stockholm (Sweden), Copenhagen (Denmark) and Helsinki (Finland). Long-haul bases in Thailand (Bangkok) and the US (New York and Fort Lauderdale).

Our fleet

- A fleet of 110 aircraft – nine of which are 787 Dreamliners. The rest of the fleet consists of Boeing 737-800s (186/189 passengers).
- We have a firm order of 150 B737 (including MAX) and 100 Airbus 320neo.
- By 2020 we will operate 40 B787s.
- The average fleet age is around four years. This means that Norwegian has one of the world's youngest and greenest fleets.



Our Destinations

From bases in **NORWAY**

norwegian

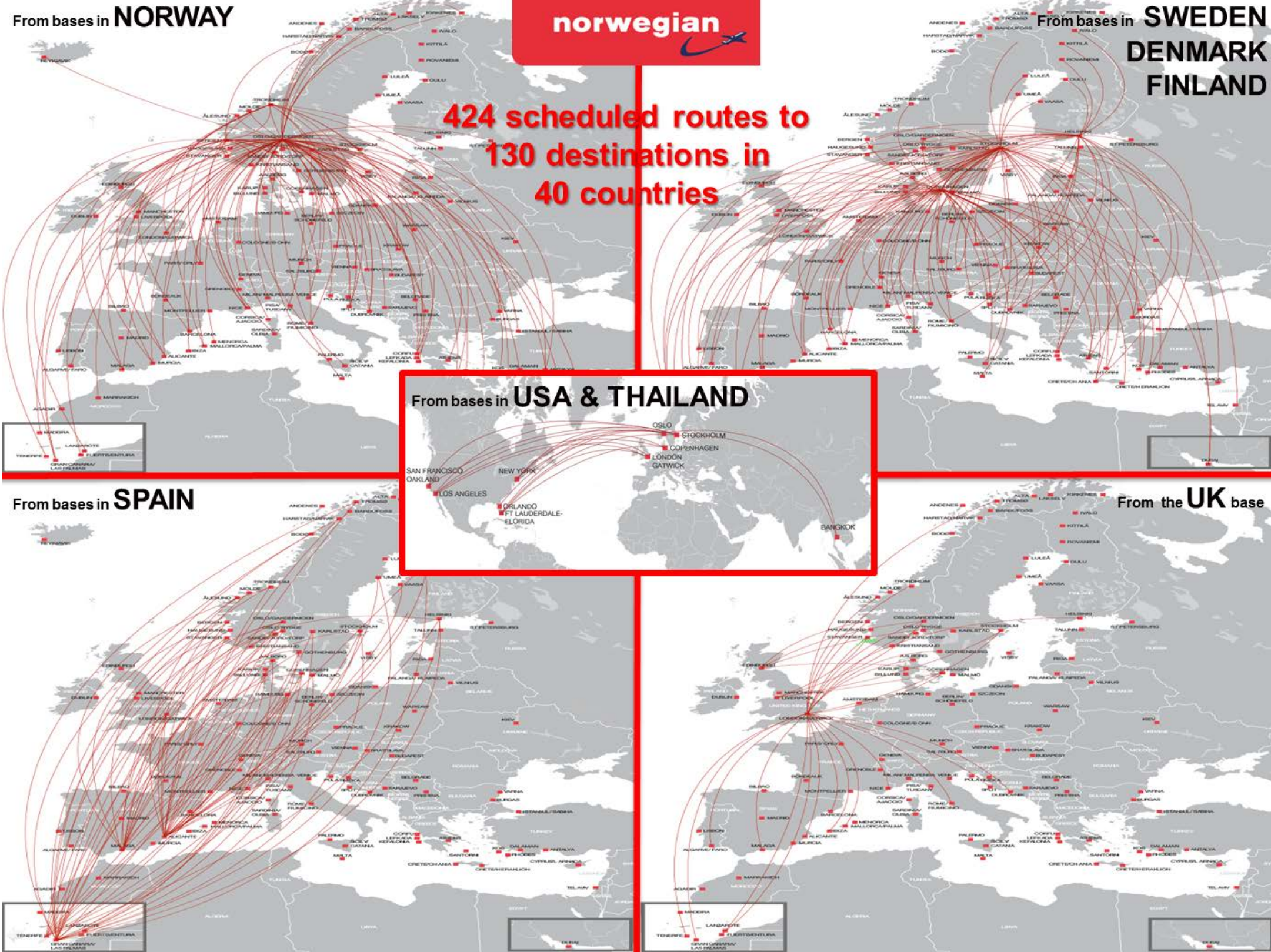
From bases in **SWEDEN**
DENMARK
FINLAND

**424 scheduled routes to
130 destinations in
40 countries**

From bases in **USA & THAILAND**

From bases in **SPAIN**

From the **UK** base



Originating from Norway...

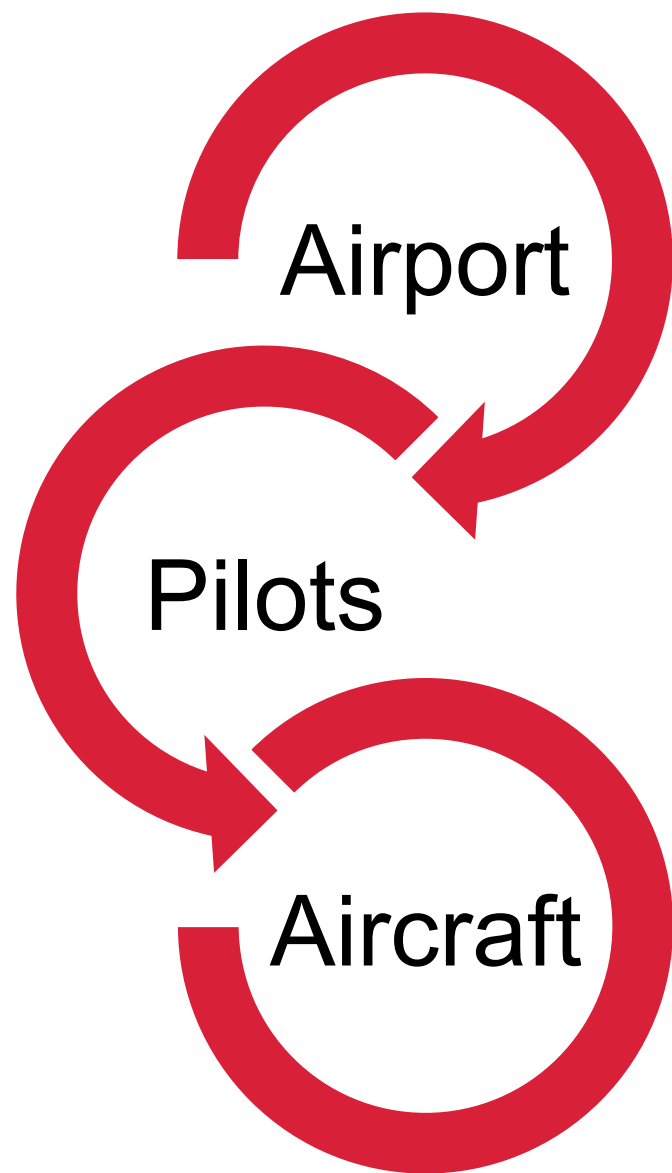
- We have extensive experience in operating on contaminated runways.
- Many of our northern destinations have stable winter conditions over a long period of time.
- From 1st Oct 2015 to 16th Mar 2016 our B737 fleet made 72280 landings in all, of which 13499 (**18.7%**) where on non-dry & non-wet runway surfaces.
- **94%** of non-dry & non-wet landings where in Scandinavia and Finland.
- **55%** of non-dry & non-wet landings where in Norway alone.
- The numbers are based on pilot reports from the aircraft EFB.
 - Pilots are requested to report experienced braking action and the airport reported braking action in their mandatory landing report.

From an operator's perspective

- We welcome the changes and appreciate the work done by ICAO to standardize the reporting format globally.
- The key words are standardization and harmonization.
- A runway with a reported RWYCC of 3 should give the same friction whether the runway lies in Alaska, Norway or Japan.



Main stakeholders




- Airport operators evaluate the runway condition.
- They are the pilots eyes on the ground.
- The pilot receive the RWYCC and consult his aircraft manuals.
- The aircraft manufacturer provide performance information iaw SNOWTAM format / TALPA ARC.
- Information chain.

Aircraft manufacturers

- Need to update their performance information iaw the new SNOWTAM format.
- When a pilot receives a RWYCC he will translate this into a Braking Action that he is familiar with.
- He will then consult his manuals or electronic support tools (EFBs, Performance tools etc.).

787-8/TRENT1000-G
EASA
Category A Brakes

 **BOEING**

Performance Inflight - QRH
Advisory Information

787 Flight Crew Operations Manual

ADVISORY INFORMATION

Normal Configuration Landing Distance
Flaps 30

	LANDING DISTANCE AND ADJUSTMENTS (M)								
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ	SLOPE ADJ	TEMP ADJ	VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	170000 KG LANDING WEIGHT	PER 5000 KG ABV/BLW 170000 KG	PER 1000 FT ABOVE SEA LEVEL	PER 10 KTS HEAD/ TAIL WIND	PER 1% DOWN/ UP HILL	PER 10°C ABV/ BLW ISA	PER 5 KTS ABOVE VREF30	ONE REV	NO REV

Medium Reported Braking Action

MAX MANUAL	1885	45/-40	65	-110/380	50/-45	50/-50	80	145	370
MAX AUTO	1905	50/-40	65	-110/385	45/-40	50/-50	90	140	360
AUTOBRAKE 4	2085	50/-40	70	-115/405	30/-20	60/-60	115	50	240
AUTOBRAKE 3	2295	60/-50	80	-125/440	30/-35	65/-65	120	25	110
AUTOBRAKE 2	2450	70/-60	95	-135/465	50/-50	70/-70	115	110	135
AUTOBRAKE 1	2565	75/-65	105	-150/505	65/-60	75/-75	115	265	300

Medium to Poor Reported Braking Action

MAX MANUAL	2090	65/-50	90	-135/485	65/-55	65/-65	95	225	615
MAX AUTO	2100	65/-50	90	-135/485	70/-60	65/-65	95	230	620
AUTOBRAKE 4	2175	60/-45	85	-130/440	50/-35	60/-60	105	160	550
AUTOBRAKE 3	2355	60/-55	80	-135/445	45/-45	65/-70	115	60	390
AUTOBRAKE 2	2485	70/-60	95	-140/470	60/-60	70/-75	105	125	255
AUTOBRAKE 1	2585	75/-65	105	-150/505	75/-65	75/-75	115	275	330

Poor Reported Braking Action

MAX MANUAL	2690	75/-65	100	-190/730	225/-135	75/-75	95	505	1570
MAX AUTO	2700	75/-65	100	-190/730	230/-140	75/-75	95	505	1580
AUTOBRAKE 4	2700	75/-60	100	-190/730	230/-135	75/-75	100	505	1580
AUTOBRAKE 3	2780	75/-65	100	-195/740	215/-130	80/-80	115	440	1520
AUTOBRAKE 2	2855	80/-70	100	-195/750	215/-140	80/-85	105	410	1445
AUTOBRAKE 1	2900	85/-70	120	-200/760	230/-145	85/-85	115	480	1400

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and 2 engines at maximum available reverse thrust.

Max Manual assumes maximum achievable manual braking.
All reference distances and adjustments are increased by 15%.
Includes a distance from threshold to touchdown associated with a flare time of 7 seconds.

Max Manual and autobrake data valid for auto speedbrakes.
For max manual braking and manual speedbrakes, increase reference landing distance by 30m.
For autobrake and manual speedbrakes, increase reference landing distance by 25 m.

Pilots...

- Need to know the runway condition codes.
- They should be familiar with them already (at least 1–5).
- No special training required.
- However, special focus on aircraft performance is always welcomed, and this is a great opportunity to enhance the competence in the pilot core.

Pilot report of runway braking action	Description	Runway condition code (RWYCC)
N/A		6
GOOD	Braking deceleration is normal for the wheel braking effort applied AND directional control is normal	5
GOOD TO MEDIUM	Braking deceleration OR directional control is between good and medium	4
MEDIUM	Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced	3
MEDIUM TO POOR	Braking deceleration OR directional control is between medium and poor	2
POOR	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced	1
LESS THAN POOR	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain	0

Pilots...

- Also need to be familiar with the Runway Condition Assessment Matrix.
- They need to be familiar with the assessment criteria.
- However, the RWYCC may not fit the runway surface description.

Runway condition assessment matrix (RCAM)				
Runway condition code	Assessment criteria		Downgrade assessment criteria	
	Runway surface description	Aeroplane deceleration or directional control observation	Pilot report of runway braking action	
6	<ul style="list-style-type: none"> • DRY 	---	---	
5	<ul style="list-style-type: none"> • FROST • WET (The runway surface is covered by any visible dampness or water less than 3 mm deep) <p><i>Less than 3 mm depth:</i></p> <ul style="list-style-type: none"> • SLUSH • DRY SNOW • WET SNOW 	Braking deceleration is normal for the wheel braking effort applied AND directional control is normal.	GOOD	
4	<p><i>-15°C and Lower outside air temperature:</i></p> <ul style="list-style-type: none"> • COMPACTED SNOW 	Braking deceleration OR directional control is between Good and Medium.	GOOD TO MEDIUM	
3	<ul style="list-style-type: none"> • WET ("Slippery wet" runway) • DRY SNOW or WET SNOW (Any depth) ON TOP OF COMPACTED SNOW <p><i>3 mm and more depth:</i></p> <ul style="list-style-type: none"> • DRY SNOW • WET SNOW <p><i>Higher than -15°C outside air temperature¹:</i></p> <ul style="list-style-type: none"> • COMPACTED SNOW 	Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced.	MEDIUM	
2	<p><i>3 mm and more depth of water or slush:</i></p> <ul style="list-style-type: none"> • STANDING WATER • SLUSH 	Braking deceleration OR directional control is between Medium and Poor.	MEDIUM TO POOR	
1	<ul style="list-style-type: none"> • ICE ² 	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced.	POOR	
0	<ul style="list-style-type: none"> • WET ICE ² • WATER ON TOP OF COMPACTED SNOW ² • DRY SNOW or WET SNOW ON TOP OF ICE ² 	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain.	LESS THAN POOR	

Airport operators

- Will be the Pilot's eyes on the ground.
- Part of the responsibility is shifted from the cockpit to the ground.
- To achieve this training is vital.
- Authorization is expensive and it takes time.

Runway condition description	Runway condition code (RWYCC)
DRY	6
FROST WET (The runway surface is covered by any visible dampness or water less than 3 mm deep.) SLUSH (less than 3 mm depth) DRY SNOW (less than 3 mm depth) WET SNOW (less than 3 mm depth)	5
COMPACTED SNOW (Minus 15°C and lower outside air temperature)	4
WET ("Slippery wet" runway) DRY SNOW (3 mm and more depth) WET SNOW (3 mm and more depth) DRY SNOW ON TOP OF COMPACTED SNOW (Any depth) WET SNOW ON TOP OF COMPACTED SNOW (Any depth) COMPACTED SNOW (Higher than minus 15°C outside air temperature)	3
STANDING WATER (Water of depth equal to or greater than 3 mm.) SLUSH (3 mm and more depth)	2
ICE	1
WET ICE WATER ON TOP OF COMPACTED SNOW DRY SNOW OR WET SNOW ON TOP OF ICE	0

Pilots...

- The RWYCC may have been subject to upgrade or downgrade.
- The table cannot always be read horizontally.
- This could be reflected in the Situational Awareness section of the SNOWTAM.

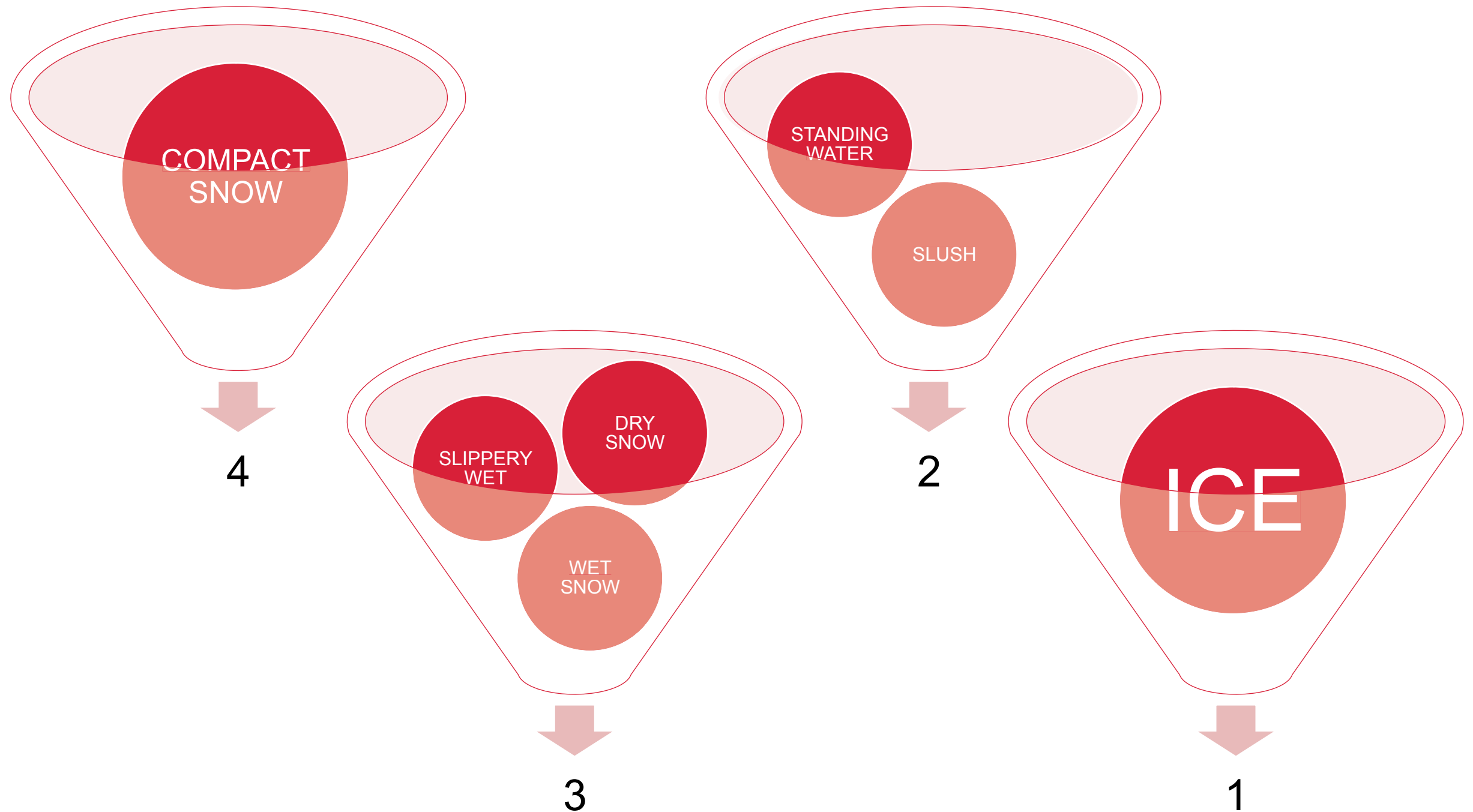
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STANDING WATER (Water of depth equal to or greater than 3 mm. SLUSH (3 mm and more depth)	2
ICE	1
WET ICE WATER ON TOP OF COMPACTED SNOW DRY SNOW OR WET SNOW ON TOP OF ICE	0

Airport operators

- The RCAM will form the basis.
- A properly trained and competent airport operator must be able to upgrade and downgrade.
- Support tools can be different ways of treating the runway, friction measuring equipment or other innovations like IRIS.

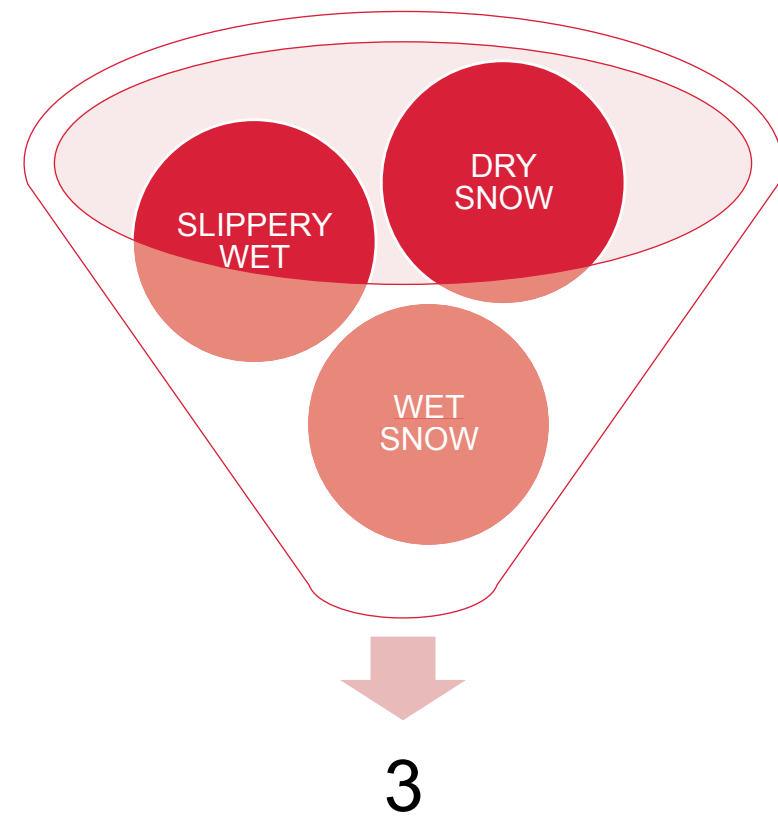
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STANDING WATER (Water of depth equal to or greater than 3 mm). SLUSH (3 mm and more depth)	2
ICE	1
WET ICE WATER ON TOP OF COMPACTED SNOW DRY SNOW OR WET SNOW ON TOP OF ICE	0

TALPA developed «buckets» of contaminants



Runway Condition Descriptions

- Each bucket contain contaminants that gives approx. the same friction.
- The buckets are the starting point of the evaluation.
- Airport personnel need to consider temperature, humidity and precipitation and use all tools available when evaluating.
- Upgrade/downgrade?



Airport operators

- In Norway, the State owned aerodrome operator has developed a self-imposed training program.
- All the personnel performing runway state reporting has been through a comprehensive training program.
- The training program ends with both a written and a practical test.
- The authorization is then valid for 4 years.

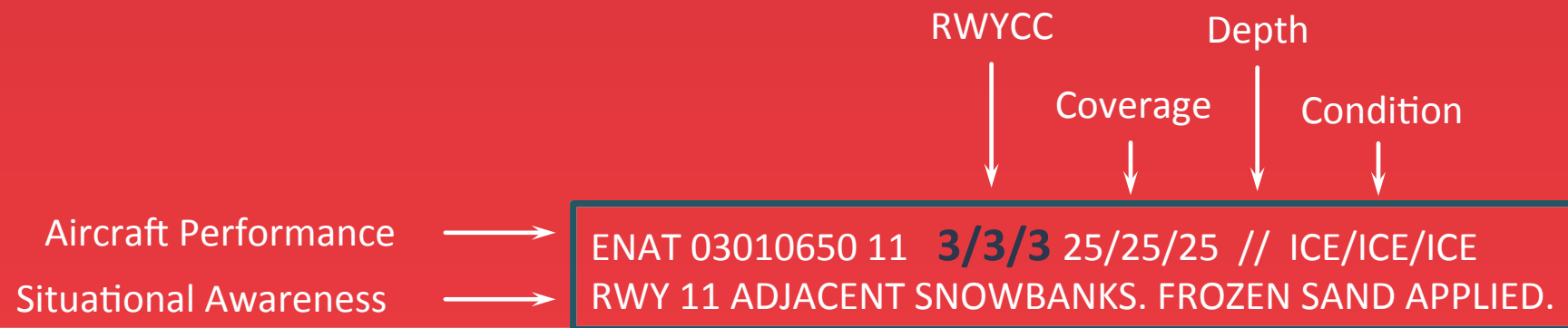


From an operator's perspective

- Norway reports estimated friction instead of measured friction.
- The quality of the reports have increased every winter season.
- We definitely see the need of a competent runway condition reporter.
- We also see the need of further development of supporting tools to help the evaluation process.



The new format may cause some challenges



>>> ENAT (ALTA RWY 11/29) <<<

METAR 010650Z 19006KT CAVOK M07/M12 Q1013 RMK WIND 700FT 17011KT

TAF 010500Z 0106/0115 19008KT 9999 FEW080

SWEN0287 ENAT 03010709
(SNOWTAM 0287

A) ENAT

B) 03010709 C) 11

F) 7/7/7 G) XX/XX/XX H) **5/5/5**

N) B/789 ALL REMAINING TWYS/79

R) APRON CENTER APRON EAST APRON GA EAST APRON GA
WEST APRON WEST/789 ALL REMAINING APRONS/79

T) CONTAMINATION/10/25/25/PERCENT.

FROZEN SAND APPLIED.

SLIPPERY PORTIONS ON TAXIWAYS. SLIPPERY PORTIONS
ON APRONS.

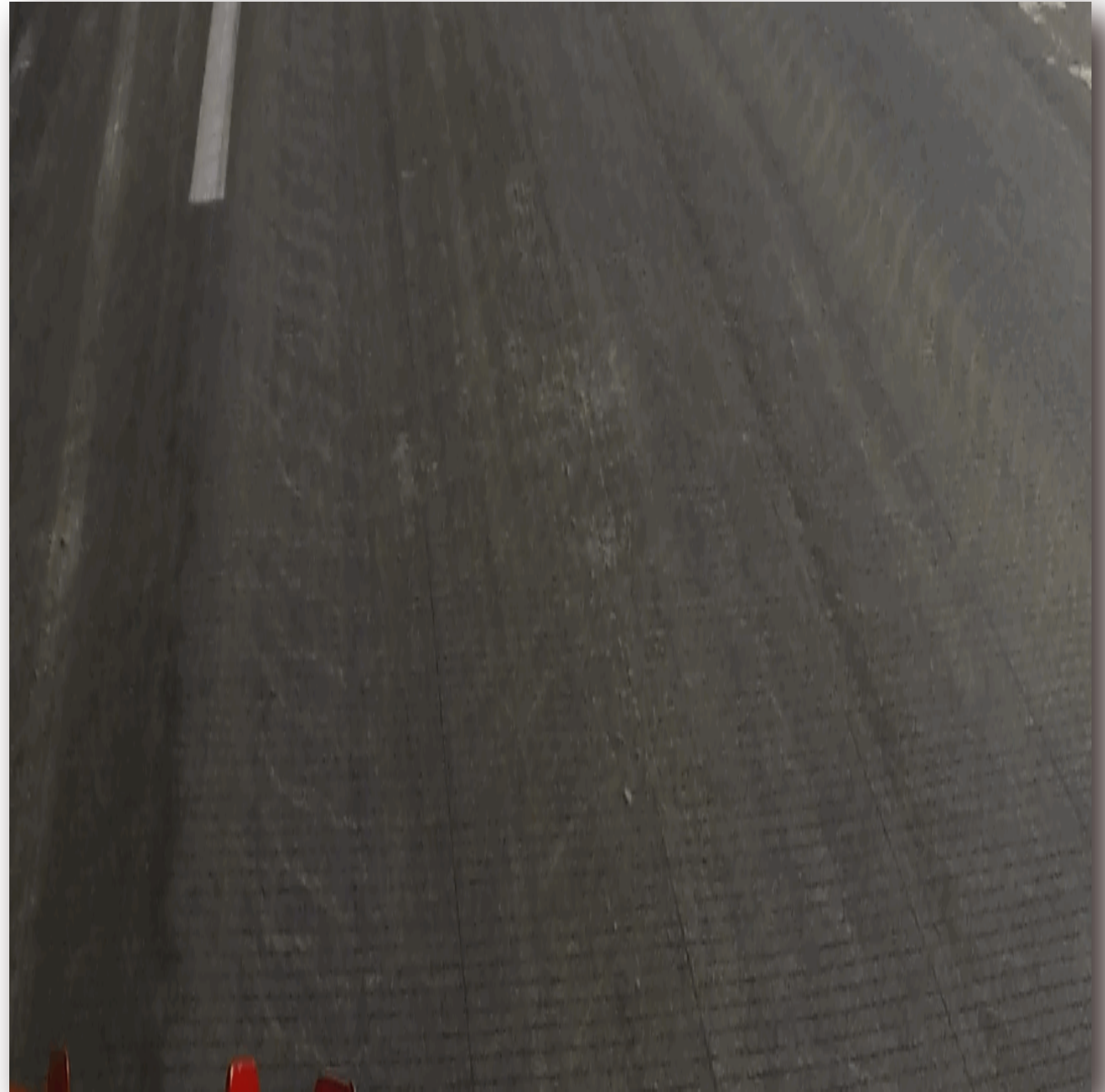
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FROZEN SAND

- Norway has used a new method of applying warm sand (frozen sand) on the runway.
- Heated pre-wetted sand is spread on an icy surface when runway temperature is sub-zero.
- The sand will be fixed to the runway and creates a sandpaper like surface.
- This has proved to be very effective.



From an operator's perspective

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- An aerial photograph of an airport runway and taxiway. The runway is a long, straight strip of asphalt with white markings, including a centerline and edge lines. To the right of the runway, there are several taxiways with similar markings. The background shows some airport buildings and a fence line. The overall scene is captured from a high angle, looking down the length of the runway.
- **When converting to the new Runway Condition Report, it is not acceptable to lower the quality of the service given.**
 - **The regulations must account for future innovations/methods that can assure an equivalent level of safety .**

Thank you for your attention!

