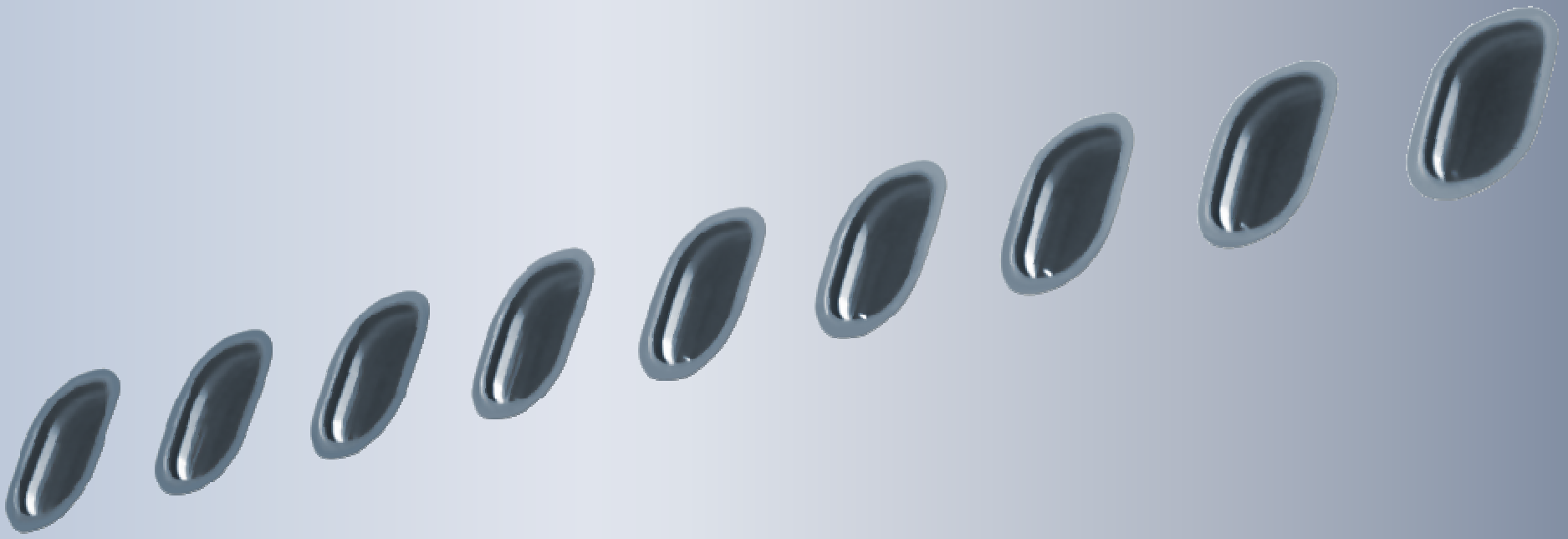


ECAST Meeting 6th March 2013

Runway Overrun Prevention System

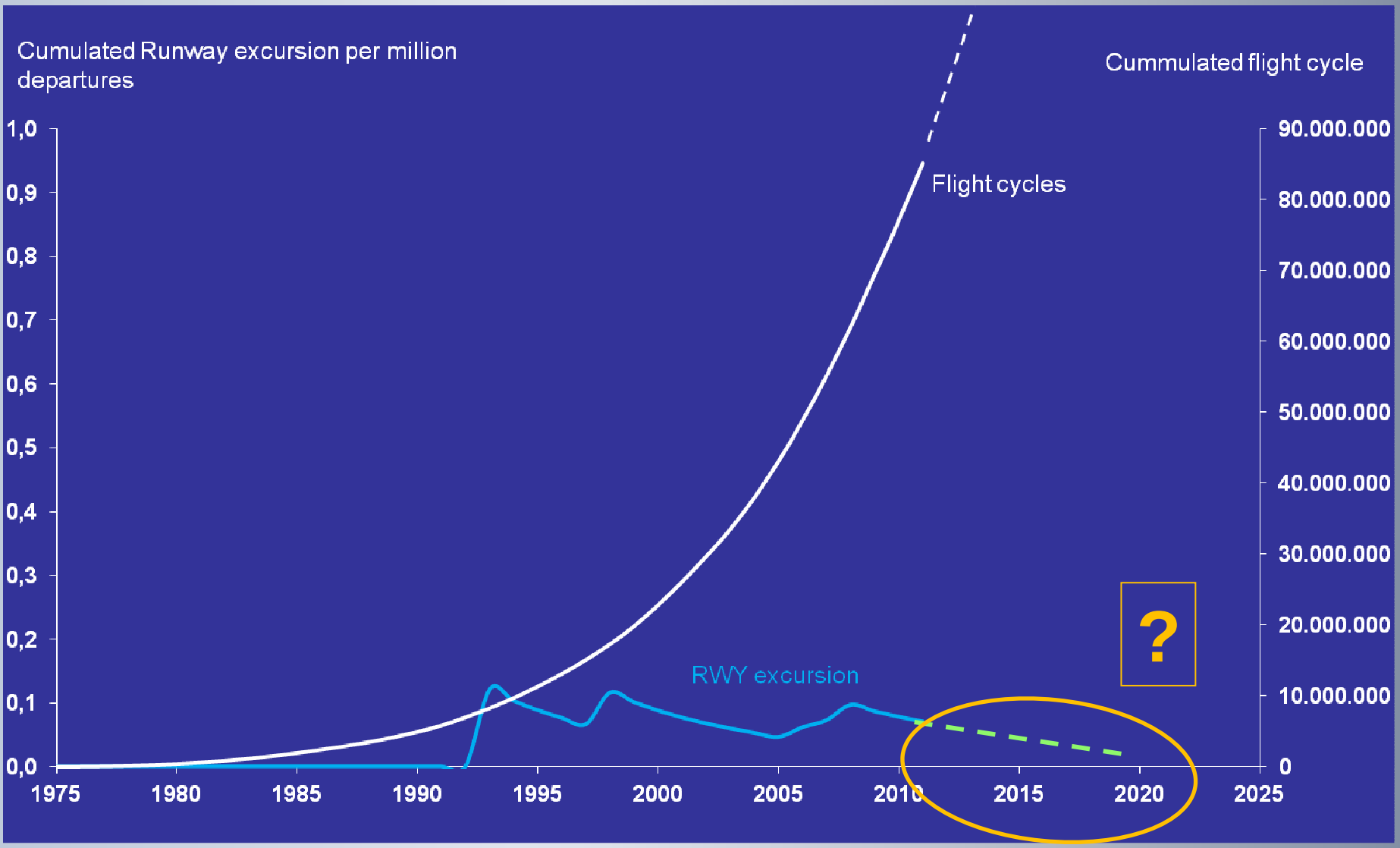
Focus on end of Runway Excursions

Presented by

Harry Nelson

AIRBUS

All Airbus aircraft – Runway excursion



ROW / ROP - The Challenge

To achieve a Reduction in Runway Excursions

AS SOON AS POSSIBLE

NTSB Safety Recommendations to FAA (March 29, 2011)

"Actively pursue with aircraft and avionics manufacturers the development of technology to reduce or prevent runway excursions and, once it becomes available, require that the technology be installed. (A-11-28)"

The Challenge

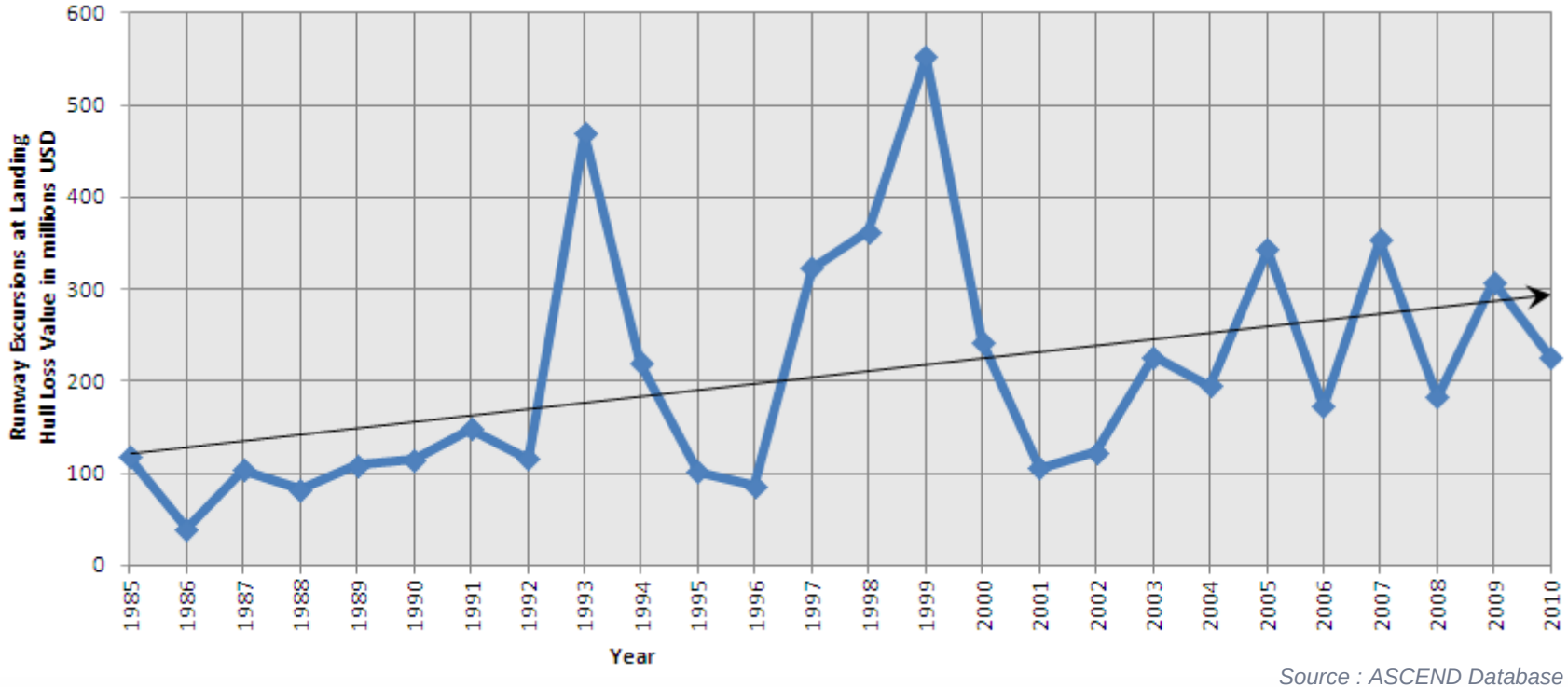
- From concept to mandate
  - TCAS: 17 years
  - EGPWS: 21 years
  - ROPS or equivalent solution: 25 years???

- Why so long?

- We have to find new ways of getting great safety ideas into general use more quickly if we want to attack today's accident rate and make a difference "tomorrow."

Safety at Landing: the n°1 Air Transportation Safety Issue

Hull Losses Claims Data over 1985-2010 Period (only claims above 10m$)



Source : ASCEND Database

Landing excursions claims: a deteriorating situation
Aviation industry now needs a game changer...

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Safety at Landing: the n°1 Air Transportation Safety Issue

Existing Situation

- Most of accident with overruns at landing follow dangerous deviations at low altitude (Toronto)

  Note - Non adherence to SOP at intermediate altitude remains exceptional

- Contributors to runway excursions at landing accidents and incidents

  - 59% touched down in the recommended touchdown zone
  - 62% experienced tailwind
  - 76% respected FSF/IATA/ICAO Stable Approach criteria
  - 100% where with perfectly healthy aircraft

Training and Procedures are not enough
Aviation industry now needs a game changer...

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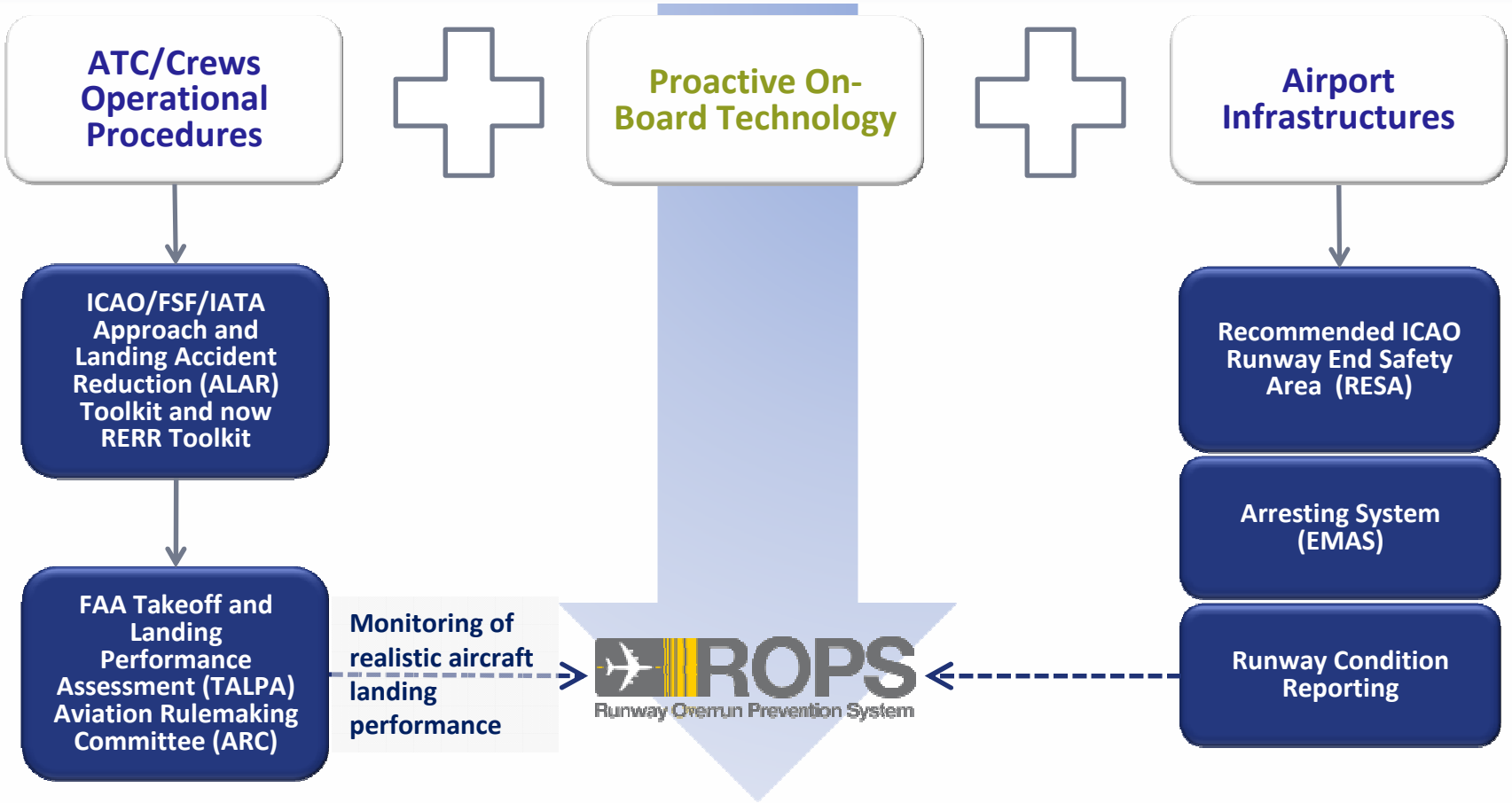
Runway Excursion Risk Mitigation Means

Technology, a Part of the Solution



Only a combined prevention approach should be effective;

Like EGPWS/TCAS, on-board technology will be key to mitigate Runway Excursion Risk

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Runway Overrun Prevention System

Design principles and Achievements

- A technology designed to monitor continuously total energy and aircraft landing performance vs. runway end, from short final up to aircraft stop

- A true guidance to assist crew in:
  - The go-around decision making process by removing doubt about the ability to continue to a safe landing
  - Gives clear and immediate assistance under changing conditions at low altitude after the normal “stabilised ‘ approach criteria points
  - The timely application of on-ground retardation means

- Very promising safety benefits, demonstrated with a review/replay of actual runway excursions and 3 years in-service experience
  - Vast majority of Airbus events would have been avoided
  - No spurious alerts reported
  - Not considered by pilots as a “too” talkative and intrusive function

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Runway Overrun Prevention System

ROPS = Runway Overrun Warning (ROW) + Runway Overrun Protection (ROP)

- ROPS automatically detects current landing runway using terrain database

- **ROW** performs a **real time in-flight landing distance assessment** with respect to detected landing distance available

  → If the detected landing distance available is assessed **too short**, ROW triggers an alert to encourage the crew to **go around**

  → On A320 Family, A330/A340 and A380, DRY and WET runway conditions are assessed

  → On A350XWB, all runway conditions are assessed

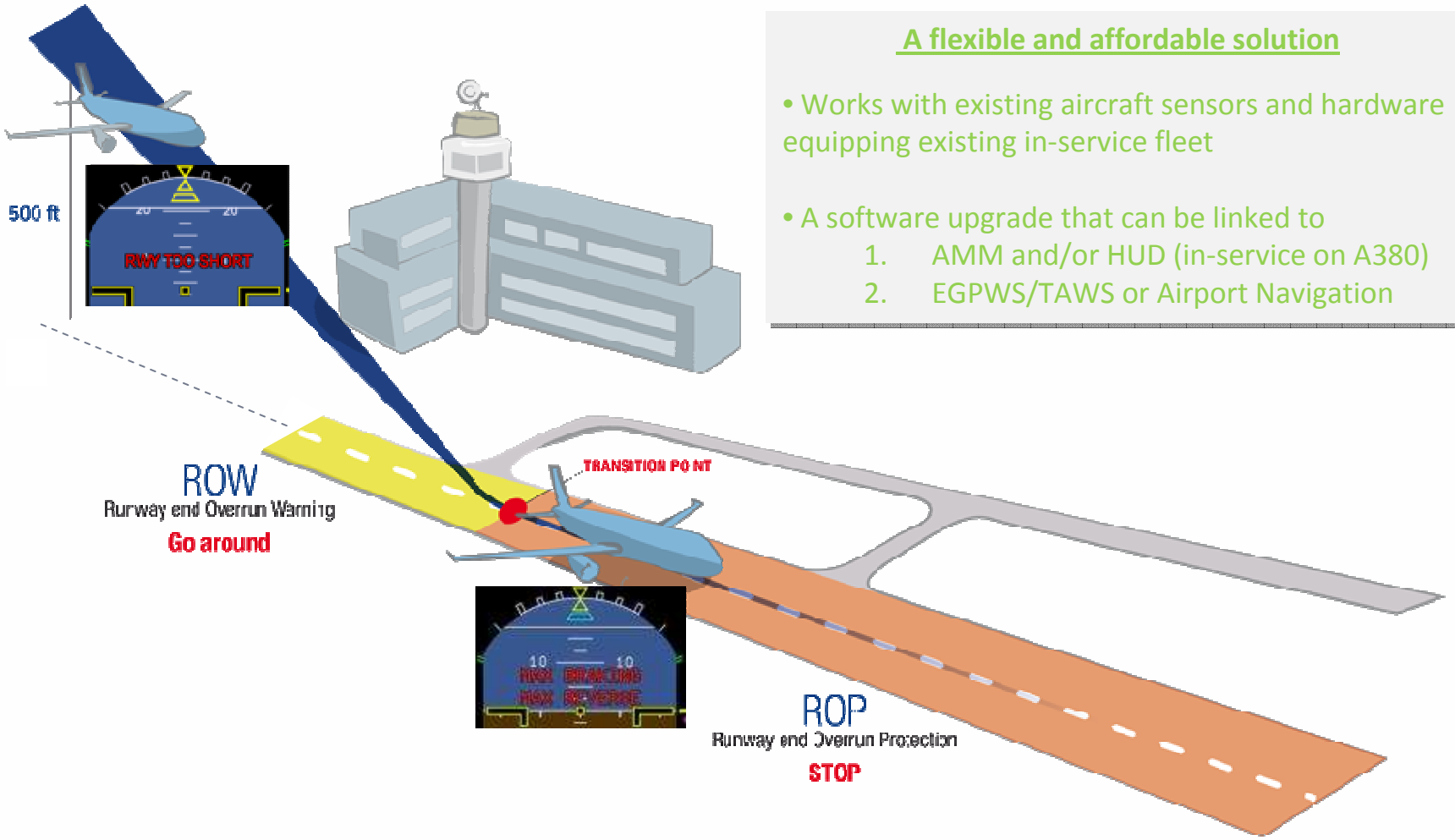
- **ROP** performs a **real time on-ground stopping distance assessment** with respect to detected landing distance available

  → If the detected landing distance available is assessed **too short**, ROP triggers an alert to encourage the crew to **apply and keep all available retardation means**

  → In such conditions, on A380 and A350 only, if the Autobrake is armed, max braking is applied automatically without delay

Runway Overrun Prevention System

Quick Description



A flexible and affordable solution

- Works with existing aircraft sensors and hardware equipping existing in-service fleet
- A software upgrade that can be linked to
  1. AMM and/or HUD (in-service on A380)
  2. EGPWS/TAWS or Airport Navigation

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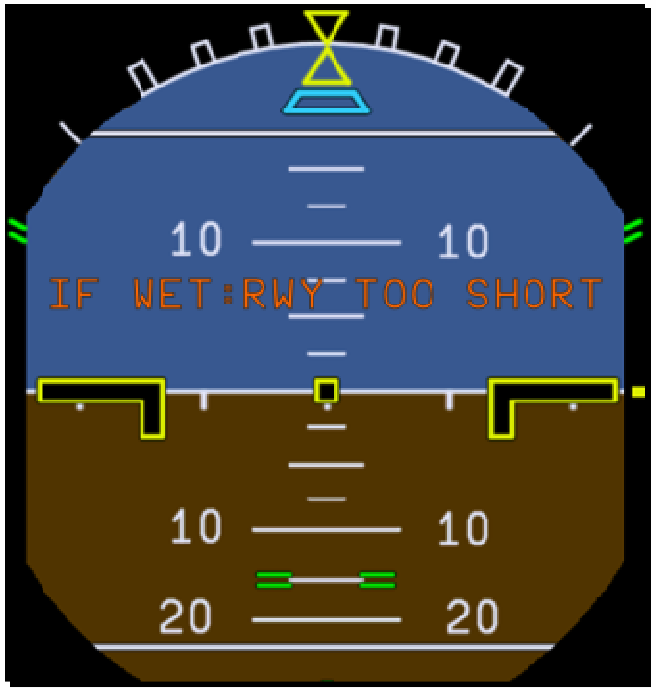
Runway Overrun Prevention System

A320 Family and A330/A340 HMI Overview

Runway Overrun Prevention System

Description of the function - ROW alarms (1/2)

If ROW WET distance to stop is longer than remaining runway length:



Below 400ft :

Amber message **on PFD** (flashing for 9s)

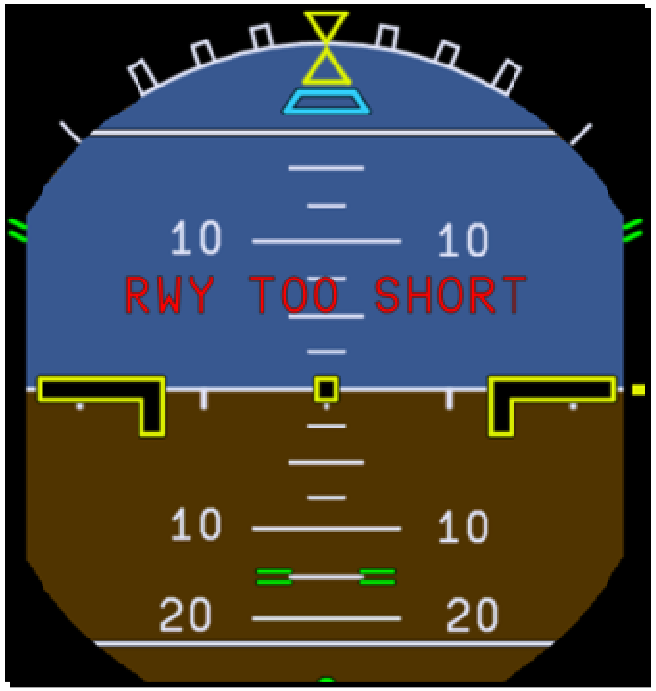
And, no audio

→ Standard Operating Procedure : Go-Around if runway is not DRY

Runway Overrun Prevention System

Description of the function - ROW alarms (2/2)

If ROW DRY distance to stop is longer than remaining runway length:



Below 400ft :

Red message **on PFD** (flashing for 9s)

And, below 200ft :

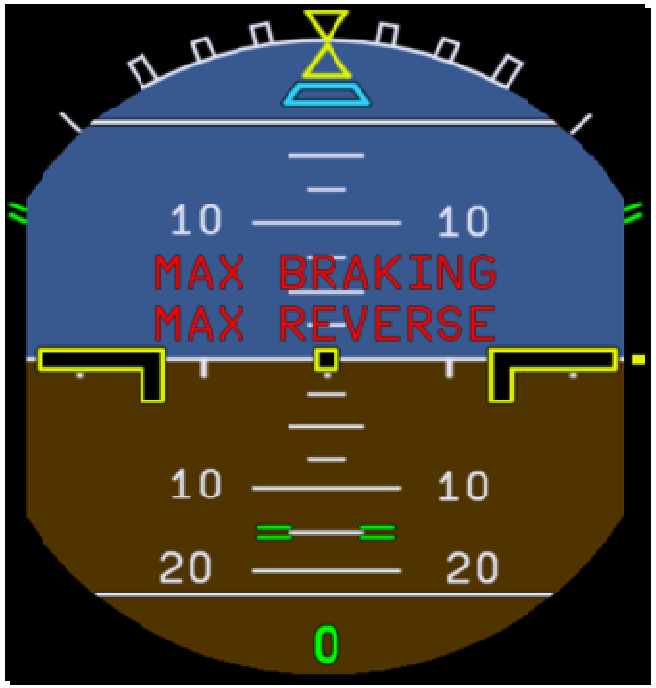
Audio callout "**RWY TOO SHORT**"

→ **Standard Operating Procedure : Go-Around (whatever runway condition)**

Runway Overrun Prevention System

Description of the function - ROP alarms

If ROP distance to stop is longer than remaining runway length:



- Red message **on PFD**
- Until max pedal deflection :

  Repetitive audio "**BRAKE… MAX BRAKING**"

  Then, until max reverse selection :

  Repetitive audio "**SET MAX REVERSE**"
- At 80kt (if still in overrun situation)

  One audio **"KEEP MAX REVERSE"**

→ **Standard Operating Procedure : Apply Full Pedals and Set/Keep Max Reverse**

Runway Overrun Prevention System

A Natural Link with In-Flight Realistic Landing Distance Assessment

In Flight

Crew proactive one-shot landing performance assessment

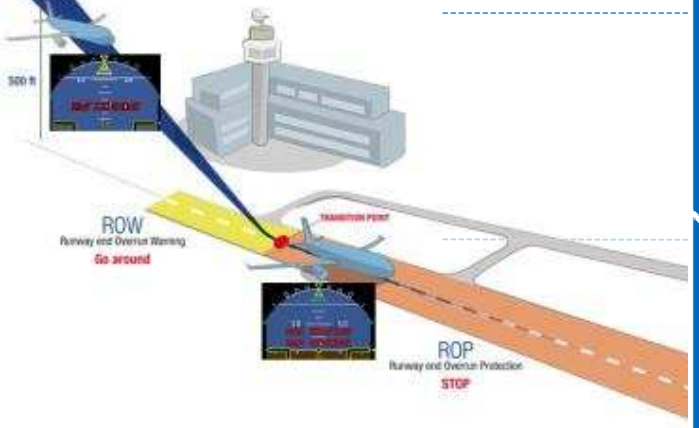
Real-time automated proactive landing performance assessment
+
Crew alerting

On Ground

Real-time automated actual stopping distance calculation
+
Crew alerting

In-flight realistic landing distance assessment by the crew

Last stabilization gate
As recommended per SOP



Pilot action based on simple SOP

Diversion

Go-Around

Max Braking
Max Reverse

Introduction of OLD and ROPS, a consistent approach
...Airbus is ready

AIRBUS

Runway Overrun Prevention System

Timeline for AIRBUS Fleet

Research
Oct. 1998 - Feb. 2002

1st Prototype
April 2004

A380
October 2009

A320 Family
2013

A330/A340
2014

A350XWB
Baseline @ EIS

Runway Overrun Prevention System

Competition vs. ROPS

Main factors of Runway Overrun at landing	Solved by
• Long flare • Stabilization not achieved at 1000/500 ft • No approved and defined realistic operational landing distance • Wind shift at low altitude • Approach becoming unstable at low altitude • Long derotation • Late selection of engine thrust reversers • Runway friction coefficient lower than expected • Cancellation of reversers at 70kts • Late/weak manual braking (w/o or after AB disc) • Failure affecting the landing distances • Contaminated runway snow, ice ... more slippery than reported, no approved realistic operational landing distance defined on contaminated runway	ROPS In-Service ROPS A350 XWB

Conclusion and Perspective

US NTSB (March 2011)

"Actively pursue with aircraft and avionics manufacturers the development of technology to reduce or prevent runway excursions and, once it becomes available, require that the technology be installed."
(A-11-28 safety recommendation to FAA)

European Aviation Safety Agency (June 2012)

Release of draft Terms of Reference to mandate existing on-board technologies on airplane
To increase the level of safety by reducing the number of runway excursions

Regional Aviation Safety Group – Pan America (October 2012)

Positive Business Case related to the deployment of ROPS-like technology to mitigate runway excursion risk in Latin America
Recommendation to implement such on-board technology

European Action Plan for Prevention of Runway Excursions (January 2013)

"On-board real time performance monitoring and alerting systems that will assist the flight crew with the land/go-around decision and warn when more deceleration force is needed should be made widely available."
(AM03 safety recommendation to aircraft manufacturers)

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(AM03 safety recommendation to aircraft manufacturers)

RASG-Pan America ROPS Installation Cost Benefits Analysis (October 2012)

Airbus believes
ROPS is that requested and already available technology,
ROPS represents a tangible short-term opportunity

AIRBUS

Conclusion and Perspective

- ROPS is a realistic solution to respond to worldwide safety agencies requests to mitigate runway excursions
  - Available for Airbus FBW aircraft
  - Accessible for all other TAWS-equipped types
- Human Factors and technical requirements have been rigorously tested
- ROPS design fully integrates operational procedures and training requirements