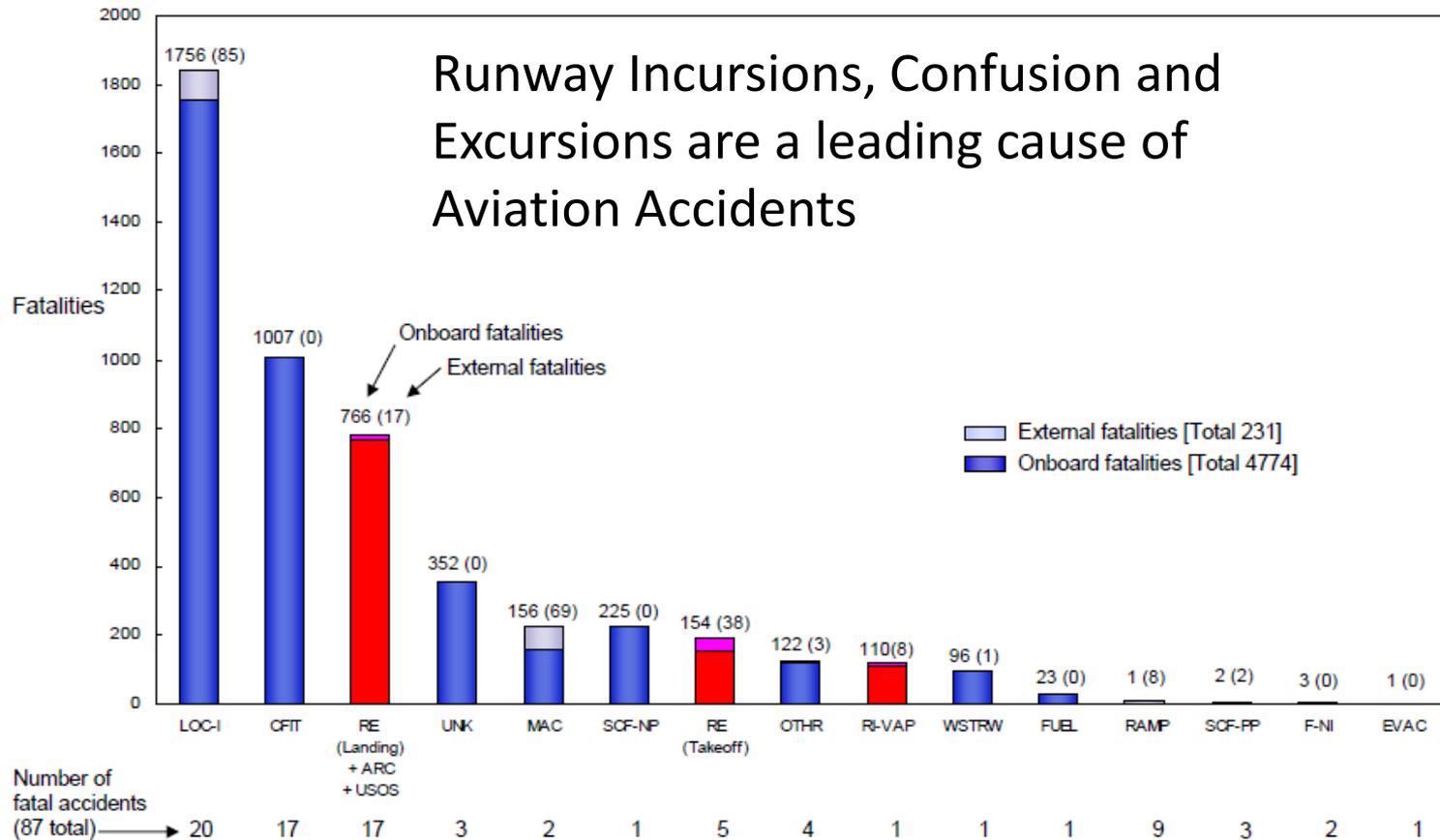# **Available Technologies**

## Session 7
## Presentation 1

**Fatalities by CAST/ICAO Common Taxonomy Team (CICTT)**
**Aviation Occurrence Categories**
Fatal Accidents – Worldwide Commercial Jet Fleet – 2001 Through 2010

Runway Incursions, Confusion and Excursions are a leading cause of Aviation Accidents

# Runway Incursion & Confusion

# Runway Incursion & Confusion

**Eliminating Runway Incursion and Confusion requires Flight Crew Awareness of:**

- – Position of Own Ship on the Airport Surface
- – Position of Other Traffic on the Airport Surface
- – Taxi Route
- – Conflicting Traffic

# Available Equipage

**Situational Awareness**

- Airport Moving Map On ND
- Airport Moving Map On Class 2/3 EFB
- Smart Runway

**Alerting**

- Runway Proximity Alerts On ND/PFD
- Runway Disagree Alerts On ND/PFD

Position Awareness (incursion/confusion)

# Available Equipage
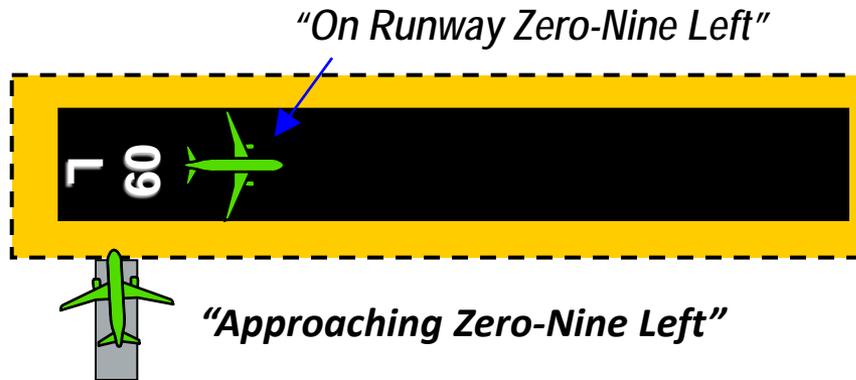
Positional Awareness via Airport Moving Map (Airbus OANS in-service example)



Runway Proximity

# Available Equipage

Positional Awareness via TAWS (Honeywell Smart Runway in-service example)



*"On Runway Zero-Nine Left"*

*"Approaching Zero-Nine Left"*

# Available Equipage

Positional Awareness via FMS (Boeing Runway Disagree Alerting in-service example)

# Future Equipage Studies

**Situational Awareness**

| Surface CDTI |
| --- |

| Taxi Route Display On Airport Moving Map |
| --- |

| Runway Status Indications On Airport Moving Map |
| --- |

Position, Taxi Route, & Traffic Awareness, Traffic Alerting

**Alerting**

| Surface Traffic Conflict Alerts |
| --- |

| Runway Incursion Alerts |
| --- |

# Future Equipage Studies

Airport Moving Map with Taxi Route, Traffic, Runway Status Indications and Traffic Conflict Alerting (Boeing concept example)
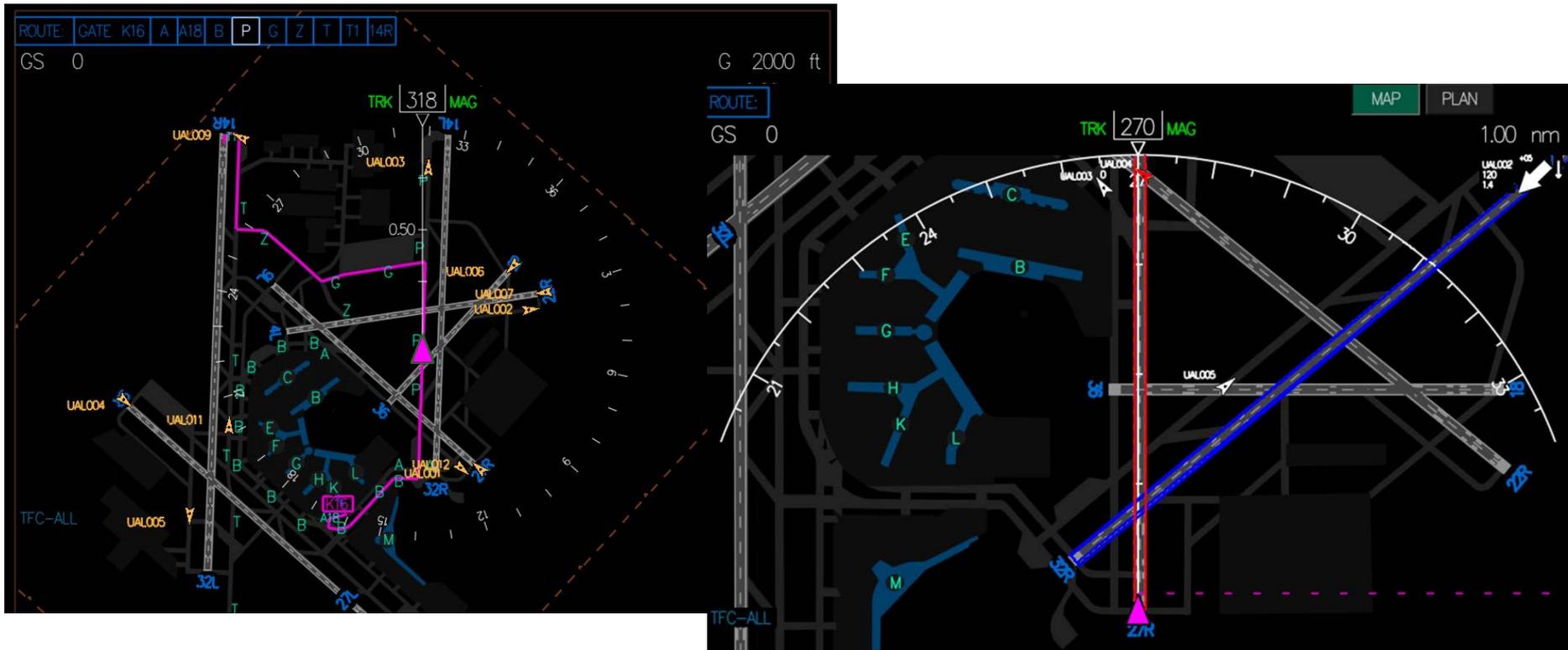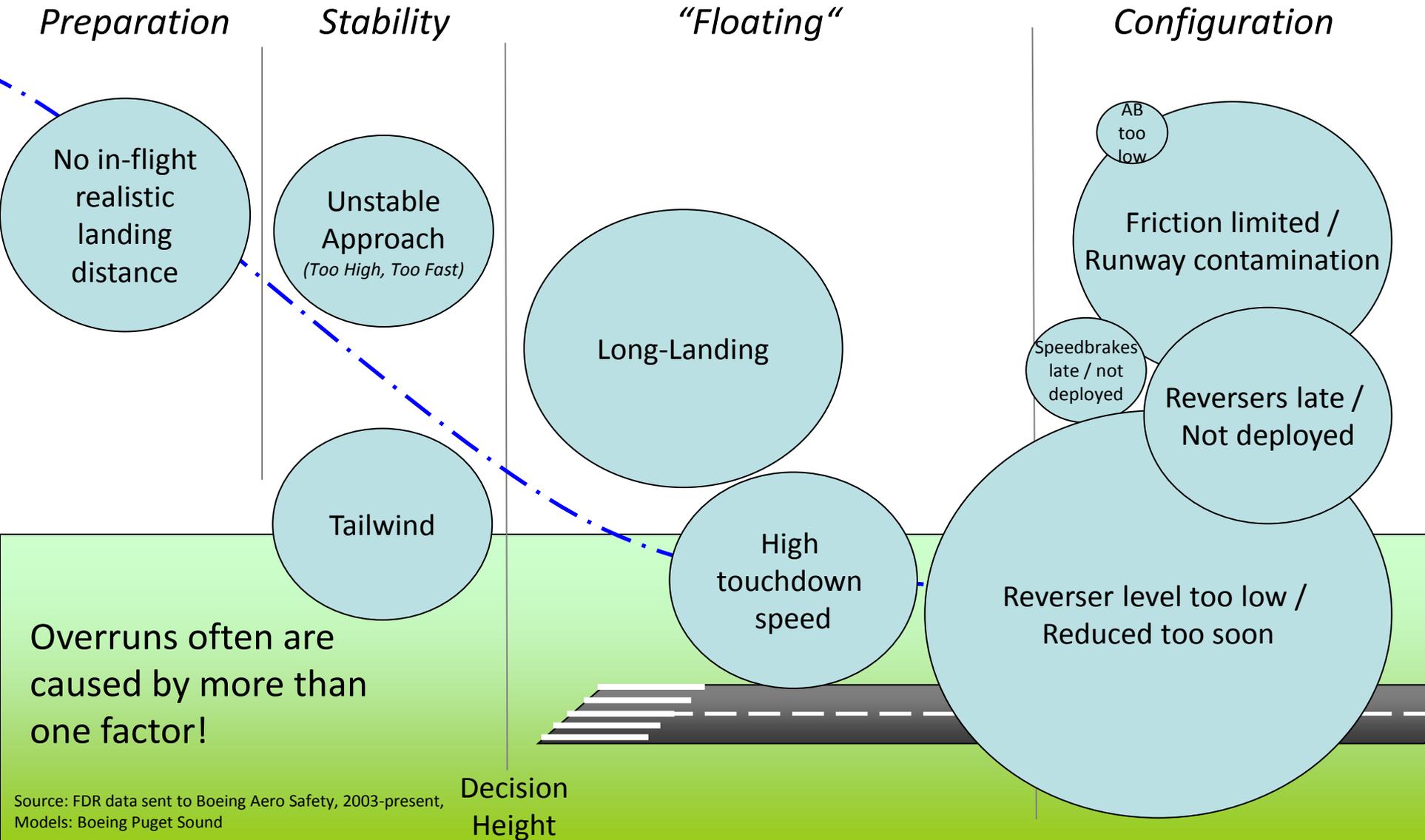
# Runway Excursions

# Overrun Characteristics

*Preparation*    *Stability*    *"Floating"*    *Configuration*

No in-flight realistic landing distance

Unstable Approach
*(Too High, Too Fast)*

Long-Landing

Tailwind

AB too low

Friction limited / Runway contamination

Speedbrakes late / not deployed

Reversers late / Not deployed

High touchdown speed

Reverser level too low / Reduced too soon

Overruns often are caused by more than one factor!

Decision Height

Source: FDR data sent to Boeing Aero Safety, 2003-present,
Models: Boeing Puget Sound

# Overrun Risk Mitigations

## *Suggested Operation and Procedural enhancement:*

| | | |
|---|---|---|
| **Runway conditions reporting** | **Touchdown zone marking** | **Use _all_ deceleration devices** |
| **In-flight realistic landing distance calculation** | **"De-stigmatize" Go- Around** | **Maintain thrust reverser deployment** |
| **Stabilized approach** | | |

## *Suggested equipage enhancements:*

| | | |
|---|---|---|
| **Stability alerting** | **Real time dynamic performance prediction** | **Real time dynamic stopping distance estimation** |
| **Real time dynamic performance prediction** | **Aural and visual Go-Around decision aids** | **Aural and visual deceleration devices usage aids** |
| **Aural and visual Go-Around decision aids** | **Head-Down and Head-Up visual cues** | **Head-Down and Head-Up visual cues** |
| **Head-Down and Head-Up visual cues** | **Flare guidance** | **Deceleration alerting** |

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**ATC/Crews Operational Procedures** + **Proactive On-Board Technology** + **Airport Infrastructures**

FSF/IATA Approach and Landing Accident Reduction (ALAR) Toolkit

FAA Takeoff and Landing Performance Assessment (TALPA) Aviation Rulemaking Committee (ARC)

Honeywell SmartLanding™

Boeing SAAFER

Airbus ROPS

Recommended ICAO Runway End Safety Area (RESA)

Arresting System (EMAS)

Runway Condition Reporting

For Runway Excursion Risk, only a combined prevention approach will be effective

**ATC/Crews Operational Procedures** + **Proactive On-Board Technology** + **Airport Infrastructures**

| | | |
|---|---|---|
| FSF/IATA Approach and Landing Accident Reduction (ALAR) Toolkit | Honeywell SmartLanding™ | Recommended ICAO Runway End Safety Area (RESA) |

Monitoring of some measured ALA aircraft parameters

| | | |
|---|---|---|
| FAA Takeoff and Landing Performance Assessment (TALPA) Aviation Rulemaking Committee (ARC) | Boeing SAAFER | Arresting System (EMAS) |
| | Airbus ROPS | Runway Condition Reporting |

Monitoring of realistic aircraft landing performance

**Guidance similar to TCAS & E-GPWS is needed to mitigate runway excursions**

## Available Equipage – Honeywell Smartlanding™

Smartlanding™ is a software upgrade of the Honeywell E-GPWS:
- Monitoring A/C speed and position vs. runway threshold
- Providing visual/aural annunciations to enhance crew awareness of unstabilized approach
- Based on tuning defined by Honeywell (speed, glideslope) or set by airlines (long landing distance)



Smartlanding™ main monitorings:
- « TOO FAST » alert,
- « TOO HIGH » alert,
- « UNSTABLE » alert,
- « LONG LANDING » alert.
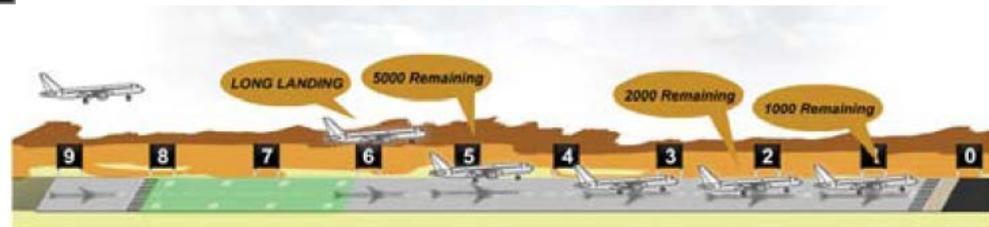
As considered as a "non interferent" function, FAA does not request:
- Demonstration of Smartlanding™ tuning relevance
- Specific training
- Specific SOP in line with exisiting operators ones

TSO approval granted in 2009

## Available Equipage – Airbus ROPS

ROPS is a low cost software upgrade of existing avionics computers:

- Continuous real time performance computation of predicted and remaining realistic operational landing distance
- Compare it/them in real time with runway end
- Trigger, only when necessary, clear alerts with simple SOP
- Guarantee and demonstrate both reliability and not excessive margins
- Ensure consistency with FAA TALPA rule and computation philosophy
- Avoid any additional tuning by airline
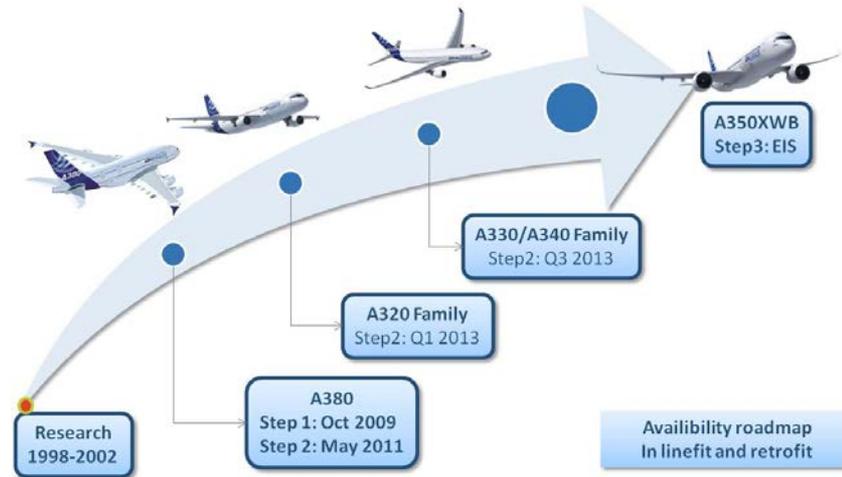- In obvious complement of the necessary need to fly stable approach
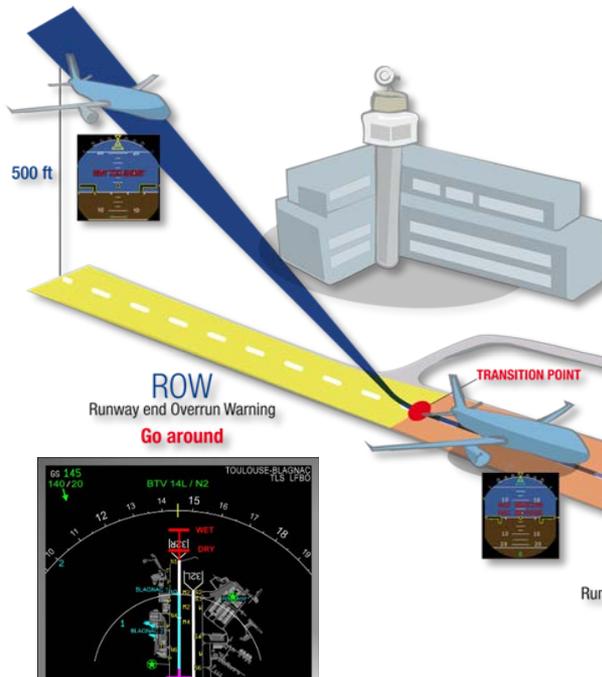


| | PFD and HUD (if installed) (Below 500 ft) | Audio (Below 200 ft) | Crew Actions (Below 500 ft) | ND line symbols (if AMM installed) |
|---|---|---|---|---|
| ROW (WET) | IF WET: RWY TOO SHORT (amber) | None | Go-Around if runway is wet / damp or more slippery | WET (amber) DRY (magenta) |
| ROW (DRY) | RWY TOO SHORT (red) | "RWY TOO SHORT !" | Go-Around | WET (red) DRY (red) |
| ROP | MAX BRAKING MAX REVERSE (red) | "BRAKE… MAX BRAKING MAX BRAKING" "MAX REVERSE" "KEEP MAX REVERSE" | MAX braking (Auto/Pilot) MAX REV (Pilots) | Red STOP bar Red path |

ROW
Runway end Overrun Warning
Go around

TRANSITION POINT

ROP
Runway end Overrun Protection
STOP

500 ft

## Available Equipage, SOP and Training – Airbus ROPS and OLD

As ROPS is considered as an "interferent" function acting in a critical flight phase, EASA requests:

- Demonstration of the relevance of ROPS alerts and protections: no unprotected area, no undue conservatism
- Principle: "If no ROW alert before decision point Then, thanks to ROP and associated SOP, no runway excursion While no significant increase of go-around rate"
- Demonstration of man-machine interface design and operational suitability
- Adequate AFM, FCOM and FCTM



A350XWB
Step3: EIS

A330/A340 Family
Step2: Q3 2013

A320 Family
Step2: Q1 2013

A380
Step 1: Oct 2009
Step 2: May 2011

Research
1998-2002

Availibility roadmap
In linefit and retrofit

ROPS flight deck technology is supplemented by the on-going implementation in Airbus SOP of in-flight realistic landing distance assessment based on FAA TALPA Operational Landing Distance (OLD) recommendations:

- Available for all Airbus types between mid-2012 (from A320 to A380) and end 2013 (A300-A310)
- Updated training media
- Updated Engineering and Performance On-board Software
- AFM, QRH and FCOM Revisions
- Airbus Type Rating Training based on OLD
- Taking into account FSF ALAR and IATA RERR recommendations

# Future Equipage and available SOP and Training – Boeing SAAFER project
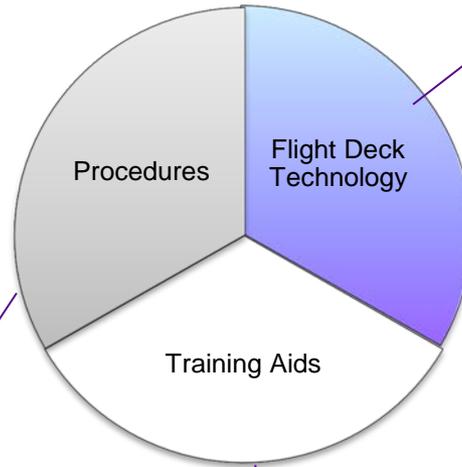


**Flight Deck Technology:**
- Enhanced approach planning tools
- Aural & visual runway positional awareness & alerting
- Stability guidance and alerting
- Predicted runway stop location display
- Overrun alerting

**Procedures**

**Flight Deck Technology**

**Training Aids**

For *every* landing:
- Calculate Landing Distance
- Calculate & brief a go-around point
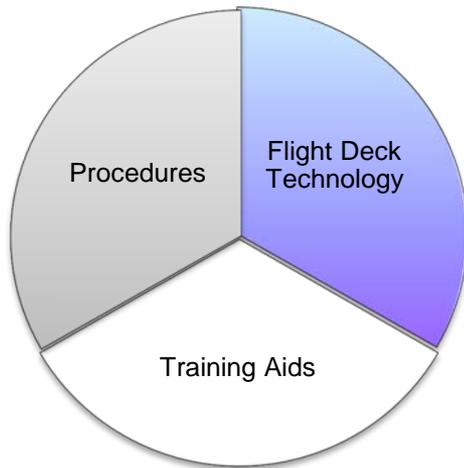- A thrust reverser callout has been added to the FCTM and the FCOM

Approach & Landing Training Aid video:
- Flying a stable approach
- Runway contamination
- Runway length available vs. required
- Reported conditions vs actual
- Approach speed additives
- Use of deceleration devices

*SAAFER: Situational Awareness & Alerting For Excursion Reduction*

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# Future Equipage and available SOP and Training – Boeing SAAFER project



**Non-Equipage mitigations available:**
- Updated Approach Procedures
- Boeing-developed Approach & Landing Training Aid
- Flight Safety Foundation ALAR tool kit
- IATA Runway Excursion Risk Reduction (RERR) toolkit

**Equipage mitigations available:**
- Heads up Display (HUD)
- Vertical Situation Display (VSD)
- Onboard Performance Tool (OPT)
- Runway Awareness Advisory System (RAAS)

## Enhanced in-production and cost-effective retrofit packages starting in 2015



737    747    767    777    787 Dreamliner

*SAAFER: Situational Awareness & Alerting
For Excursion Reduction*

# Conclusion

- **Flight deck solutions already exist or are coming**

- **Significant fleet coverage is needed to achieve widespread safety benefit**

- **Bodies starts to recommend installation of such flight deck solutions**

  - *US: NTSB (A-11-28, March 29th 2011)*

  - *Europe: EASA-Eurocontrol EAPPRE (AC05 for aircraft operators – AM03 for aircraft manufacturers)*

- **Harmonization of certification standard is requested**

  - *Current and future airplanes*

  - *High quality runway and airport data (Airport Mapping DB, Terrain DB, etc.)*

  - *TAWS development and deployment lessons learnt*

# THANK YOU