



# Incorrect Take-off Performance

5<sup>th</sup> June 2019

# Introduction

- Incorrect take-off examples
- Define the errors
- Actions
- Next steps

# Incorrect Take-off

- Boeing 777 at London Heathrow – Full runway length data used for initial calculation, but Flight Crew accepted an intersection departure.
- Boeing 737 at Belfast – Incorrect data entered in the Assumed Temperature field resulting in incorrect take-off thrust
- Airbus A320 at Luton - Intersection departure with full length data used.
- Airbus A320 at Malaga – reciprocal runway data used for departure
- Airbus A320 at Belfast – System anomaly defaulted to wrong runway

# Incorrect Take-off

- Boeing 777 at Paris Charles de Gaulle— Aircraft departed using 100,000kgs lower TOW data
- Airbus A320 at Lisbon - Intersection departure with full length data for reciprocal runway used.
- Airbus A320 at Lisbon - Intersection departure with full length data
- Embraer ERJ 190 at London City – Incorrect take-off thrust setting
- B737-800 India - impacted a low wall at the departure end of the runway in use....

# Incorrect Take-off

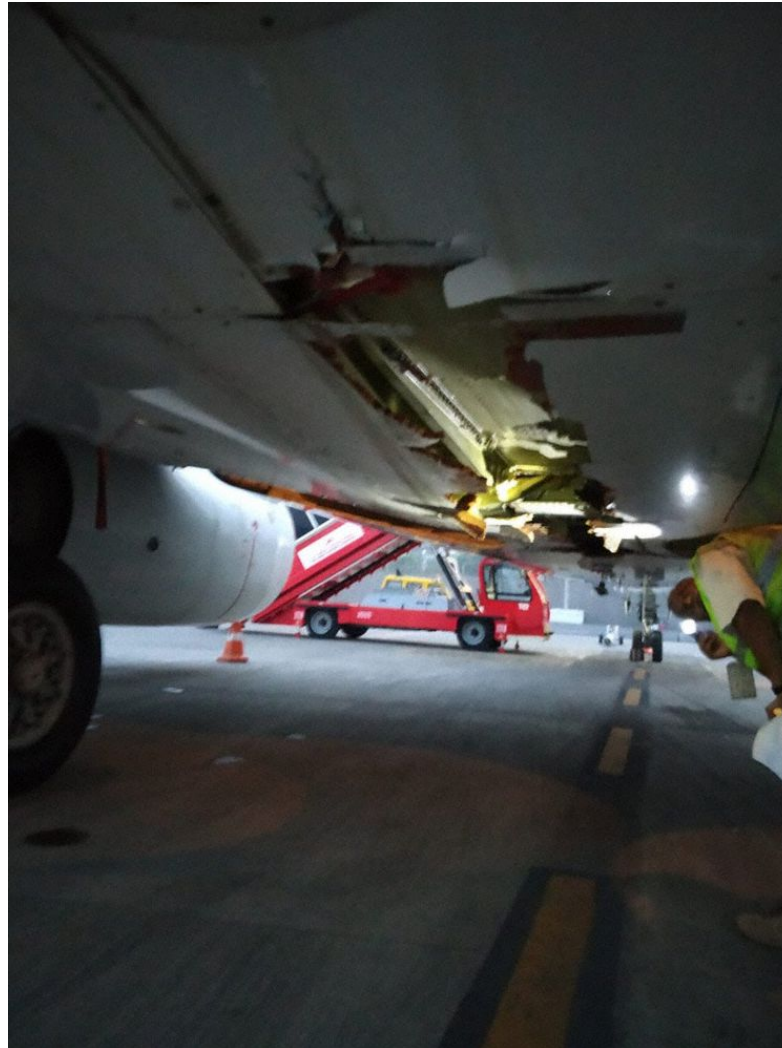




# Incorrect Take-off



# Incorrect Take-off



Ref: <http://www.avherald.com/h?article=4bedd321&opt=0>

# Errors

- Incorrect data entry
- Intersection departures
- Incorrect Flap
- Wrong runway



# Actions and Next steps.....

- UK CAA set up Working Group after BFS event
- Crew awareness/education on criticality
- Operator responsibility (SOP/FDM)
- Technological barriers e.g. acceleration monitor



# Incorrect Take-off Performance

.... The Next Steps - Technological barriers

# The issue....

## Errors



- Incorrect data entry
- Intersection departures
- Incorrect Flap
- Wrong runway

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## Take off Events: Contributing factors

- Late change of departure runway
- Time pressure, workload
- Distraction, reduced attention, interruption
- No crosscheck
- SOP not followed or done out of sequence
- Crew new on aircraft type
- Crew unfamiliar with airport
- Airport surface infrastructure, “hot spot”

# Engagement with Industry on technological barriers

Functions developed to support detection of errors

FUNCTION	CHECK PERFORMED
TO Configuration push button	Trim inside Green Band Flap not in Clean or Full
Take-Off Surveillance <b>TOS1</b>	FMS entry error Setting of Flap, CG and Trim
Take-Off Surveillance <b>TOS2</b>	TO distance A/C position with regards to runway
Take-Off Monitoring <b>TOM</b>	TO acceleration

## Take Off Surveillance functions

To detect:

- Erroneous configuration
- Entry Gross Error  
Erroneous
- Aircraft position and performance
- Too low aircraft acceleration



# Different checks at different phases

PRE FLIGHT

TAXI

T.O. POWER

T.O. ROLL

Take Off  
Surveillance  
functions





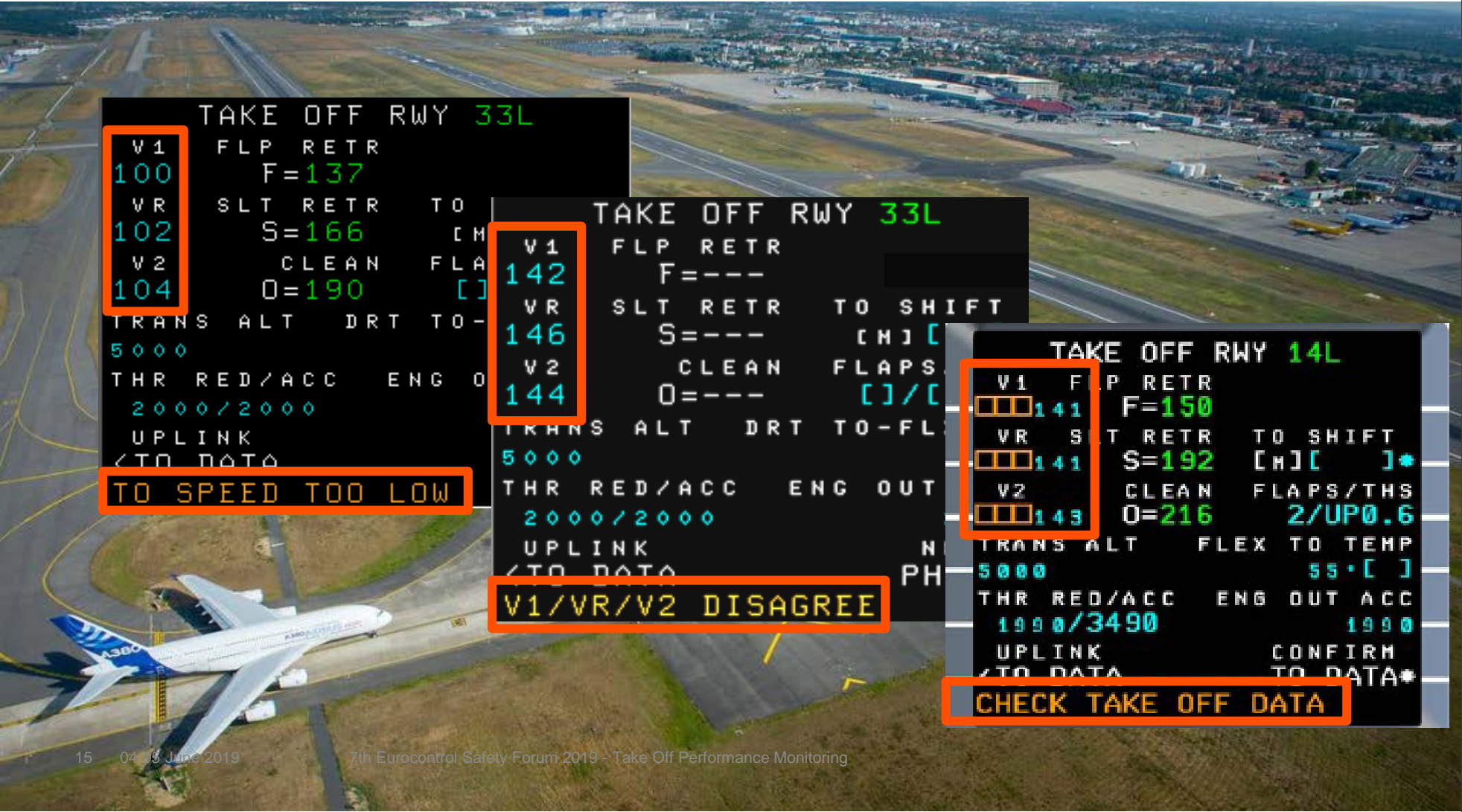
# Pre-Flight: Take-Off Surveillance (TOS) 1



## Take Off Surveillance functions

### Detection of FMS entry errors:

- Erroneous weight (ZFW) and TO speeds
- No TO speeds





# Pre-Flight: Take-Off Surveillance (TOS) 2

PRE FLIGHT

TAXI

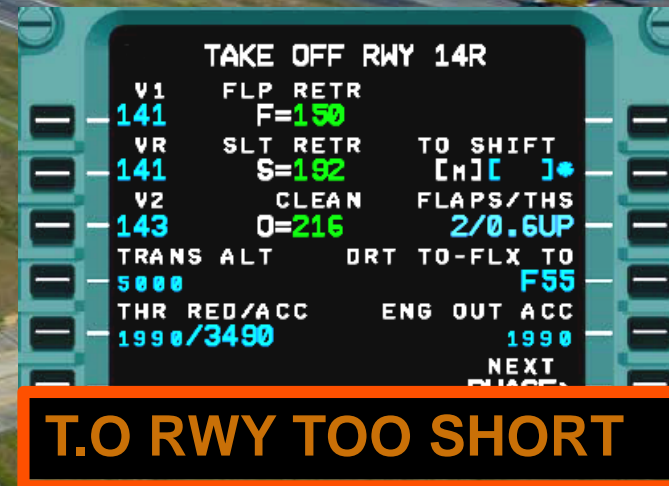
T.O. POWER

T.O. ROLL

## Take Off Surveillance functions

Take off distance check to detect:

- Too short runway distance (*RTO not considered*)





# Taxi: Take-Off Surveillance (TOS) 1

PRE FLIGHT

**TAXI**

T.O. POWER

T.O. ROLL

T.O  
CONFIG

MASTER  
CAUT



**F/CTL FLAP/FMS DISAGREE**

**F/CTL PITCH TRIM /FMS/CG DISAGREE**

**F/CTL FLAP/MCDU DISAGREE**

**F/CTL PITCH TRIM /MCDU/CG DISAGREE**

## Take Off Surveillance functions

ECAM & AUDIO alerts in case of:

- Erroneous TRIM / CG / FLAP setting  
(with regards to FMS input)



# Taxi: Take-Off Surveillance (TOS) 1 & 2

PRE FLIGHT

TAXI

T.O. POWER

T.O. ROLL

T.O  
CONFIG

MASTER  
CAUT



**T.O SPEEDS NOT INSERTED**

TOS1

**T.O SPEEDS TOO LOW**

TOS1

**T.O V1/VR/V2 DISAGREE**

TOS1

**T.O RWY TOO SHORT**

TOS2

## Take Off Surveillance functions

ECAM & AUDIO alerts in case of:

- No TO speeds
- Erroneous TO speeds
- TO distance too short



# Take-Off Power: Take-Off Surveillance (TOS) 2

PRE FLIGHT

TAXI

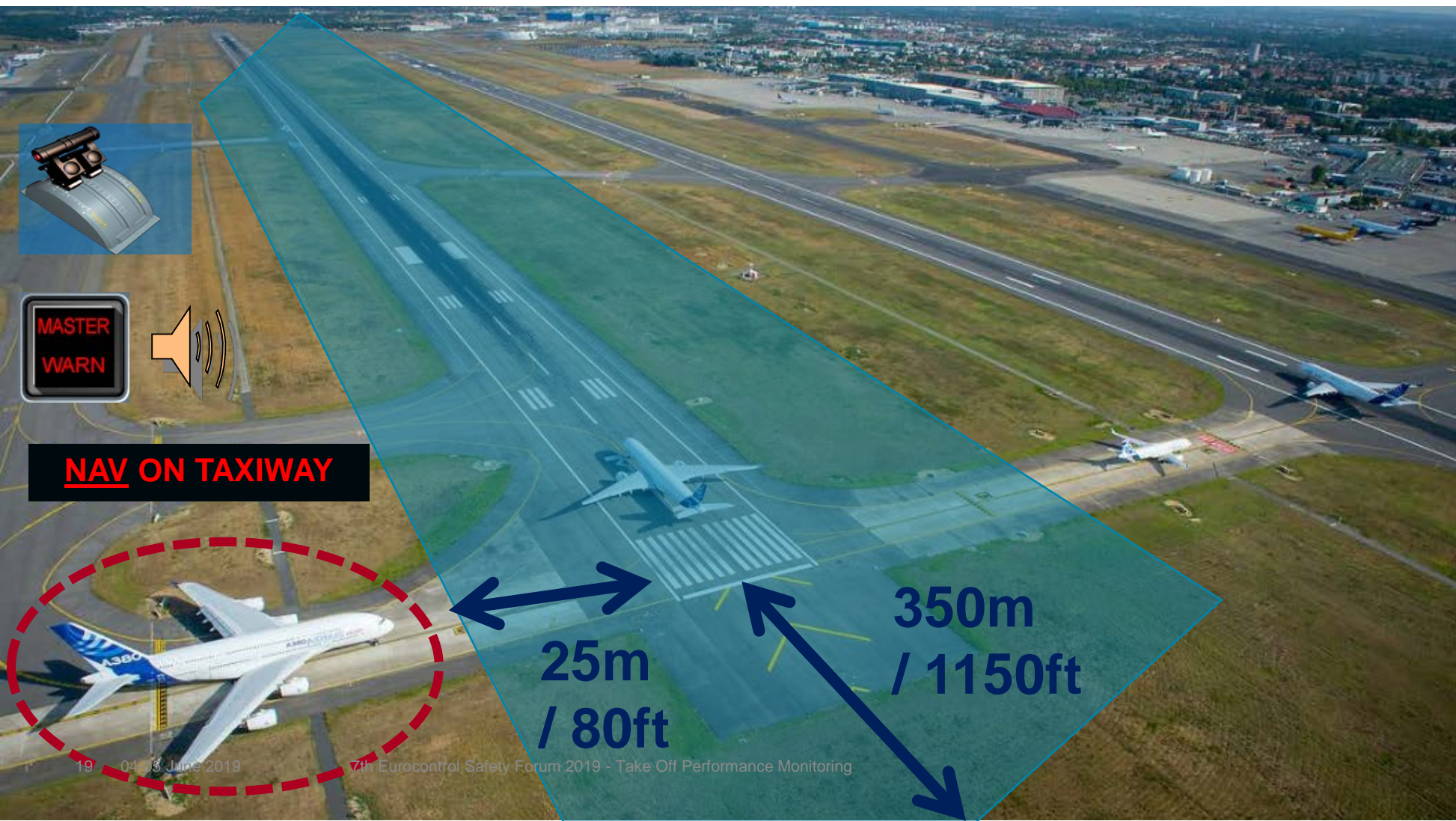
T.O. POWER

T.O. ROLL

## Take Off Surveillance functions

Aircraft position check to detect:

- Take off initiation on taxiway





# Take-Off Power: Take-Off Surveillance (TOS) 2

PRE FLIGHT

TAXI

T.O. POWER

T.O. ROLL

## Take Off Surveillance functions

Aircraft position check to detect:

- Take off initiation not on FMS runway





# Take-Off Power: Take-Off Surveillance (TOS) 2

PRE FLIGHT

TAXI

T.O. POWER

T.O. ROLL

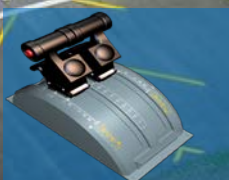
## Take Off Surveillance functions

Aircraft position check to detect:

- Expected A/C performance not compatible with available runway distance



**T.O RWY TOO SHORT**





# Take-Off Roll: Take-Off Monitoring (TOM)

PRE FLIGHT

TAXI

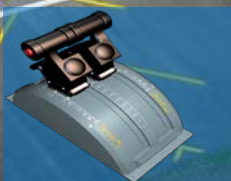
T.O. POWER

T.O. ROLL

**T.O ACCELERATION DEGRADED**



**CAS  
90kt**



## Take Off Surveillance functions

Aircraft acceleration check to detect:

- Abnormal acceleration

Alert at 90kt



# Return of Experience

- **Airbus A330 at Montego** – Erroneous weight - data entry
- **Airbus A320 at Luton** – Residual runway length (sufficient take off distance)
- **Airbus A320 at Malaga** – Selected runway vs actual runway
- **Airbus A320 at Belfast** – Selected runway vs actual runway
- **Airbus A320 at Lisbon (reciprocal Runway)** – Selected runway vs actual runway
- **Airbus A320 at Lisbon (intersection)** – Residual runway length (sufficient take off distance)

## Take Off Surveillance functions

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Could technology have helped??

- Most errors can be avoided by **adherence to SOP** and existing technology. However, in service experience shows **errors will still occur**.
- **Contributing factors** include **late changes** before take off and **time pressure**.
- This issue been identified as a concern by the **industry** and **technological barriers** can provide another safety net.
- Airbus **Take Off Surveillance & Take Off Monitoring** functions support the industry experience.
- These functions are (being) **developed for the fleet →** but **technical capability** needs to be taken into consideration.

## Conclusions

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