

# Technology to support risk based training programs

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# Agenda

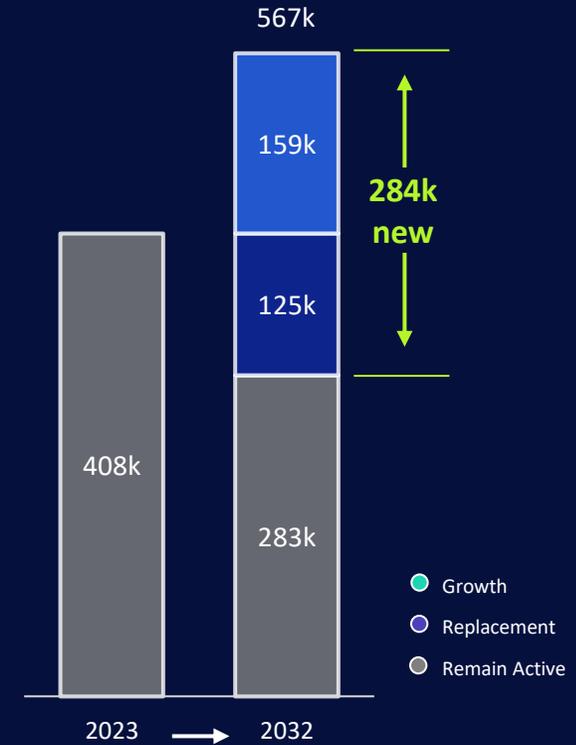
1. A training response to the pilot demand forecast.
2. Supporting technology.
3. The collection and analysis of accurate training data.

Technology to support Risk Based Training Programs

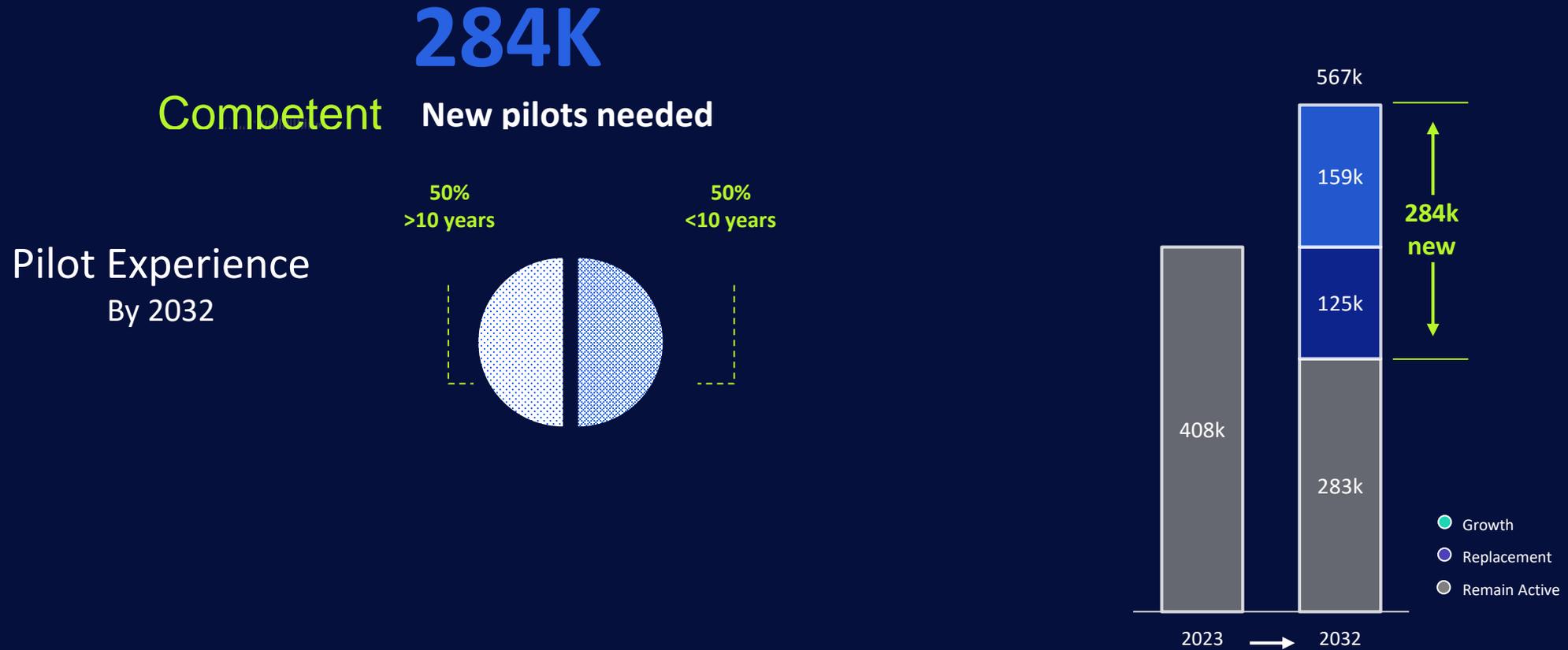
# A training response to the pilot demand forecast

# Civil Aviation Talent Forecast

**284K**  
New pilots needed



# Civil Aviation Talent Forecast



“Meet the numbers” and manage the risk of a reduction in overall “relevant” experience.

# Risk based training programs?

**The training, assessment and competence management activities developed to reduce the risks associated with flight operations.**

- “AQP seeks to reduce the probability of crew-related errors by aligning training and evaluation requirements more closely with the known causes of human error.” (AC 120-54A)
- “The purpose of CBTA is to train and assess the capacity of an individual to perform at the standard expected in an organizational workplace.” (ICAO DOC 9865)

Risk Based Training programs provide the assurance that competence demonstrated in the context of training can reliably predict successful performance on the job in the operational context.

# Traditional training vs. Risk based training

Traditional Training	Risk Based Training

# What does the move to risk based training mean for the training system?

Program characteristics	Consequences for the training system
<ul style="list-style-type: none"> <li>• Training required to perform the job on day 1.</li> </ul>	
<ul style="list-style-type: none"> <li>• Focus on <u>all</u> competencies required to do the job in operations. i.e. extend focus to leadership/teamwork, situation awareness, communication, decision making etc.</li> </ul>	
<ul style="list-style-type: none"> <li>• Success is measured by the ability to demonstrate behaviours required for safety, in complex immersive scenarios.</li> </ul>	
<ul style="list-style-type: none"> <li>• Equal Focus on Process (behaviour) and Outcome (exceedances).</li> </ul>	
<ul style="list-style-type: none"> <li>• Focus is on preparing for both the known and the unforeseen.</li> </ul>	
<ul style="list-style-type: none"> <li>• Focus is on Threat and Error Management.</li> </ul>	
<ul style="list-style-type: none"> <li>• Focus is on preparing to deal with Startle ,Surprise, and developing Resilience</li> </ul>	
<ul style="list-style-type: none"> <li>• Training and Operational data analysis, are mandatory.</li> </ul>	

People and Technology consequences

# What does the move to risk based training mean for the training system?

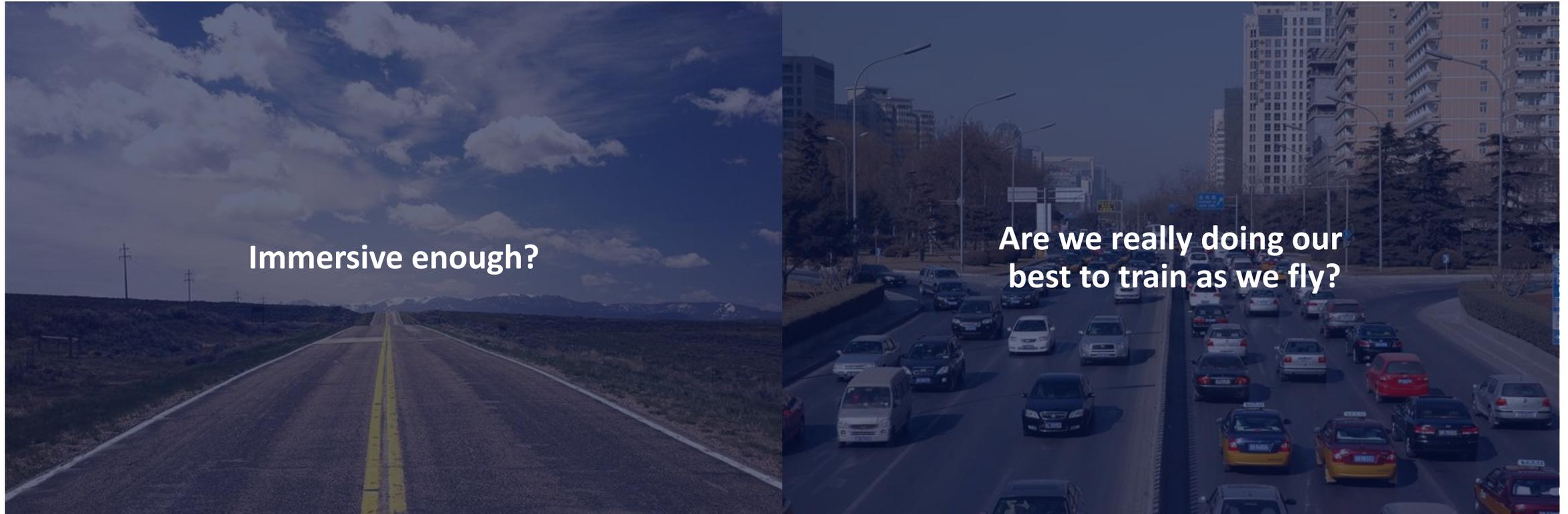
Program characteristics	Consequences for the training system
<ul style="list-style-type: none"> <li>• Training required to perform the job on day 1.</li> </ul>	<ol style="list-style-type: none"> <li>1. Instructor training/monitoring to evaluate ALL competencies.</li> <li>2. Reduce Instructor workload- to allow focus on crew behaviours.               <ul style="list-style-type: none"> <li>• Automatic Lesson Plans.</li> <li>• AI to simulate real time ATC. (voice and digital)</li> <li>• <b>Telemetry to capture error, exceedances.</b></li> <li>• <b>Biometrics to supplement instructor observations.</b></li> </ul> </li> <li>3. Ability to accurately simulate the “Job” environment.               <ul style="list-style-type: none"> <li>• <b>Simulation of “Subtle” and/or “Highly Improbable” scenarios.</b></li> <li>• <b>AI to simulate real time ATC.</b></li> </ul> </li> <li>4. Establish <b>a data collection and analysis infrastructure.</b></li> </ol>
<ul style="list-style-type: none"> <li>• Focus on <u>all</u> competencies required to do the job in operations. i.e. extend focus to leadership/teamwork, situation awareness, communication, decision making etc.</li> </ul>	
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## People and Technology consequences

Technology to support Risk Based Training Programs

# Supporting Technology

Immersion in the accurate operational context accelerates the development of relevant experience.



Assurance that competence demonstrated in the context of training can reliably predict successful performance on the job in the operational context?

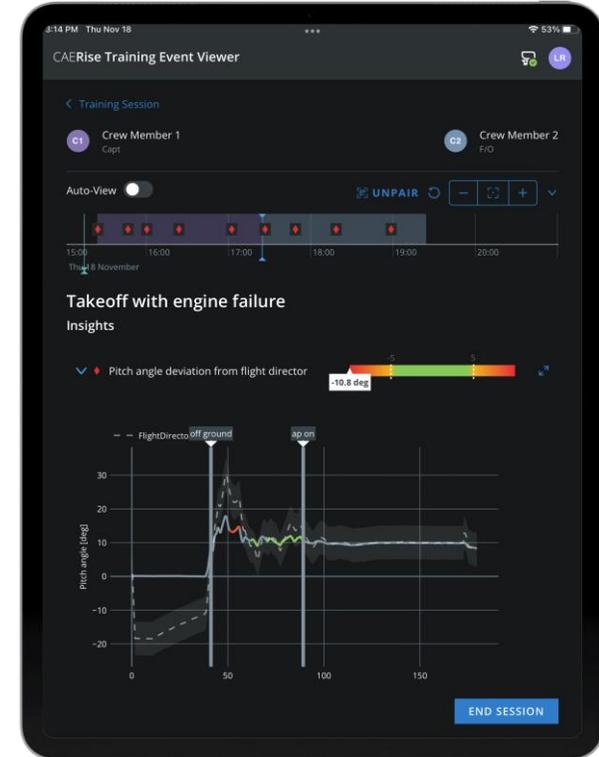
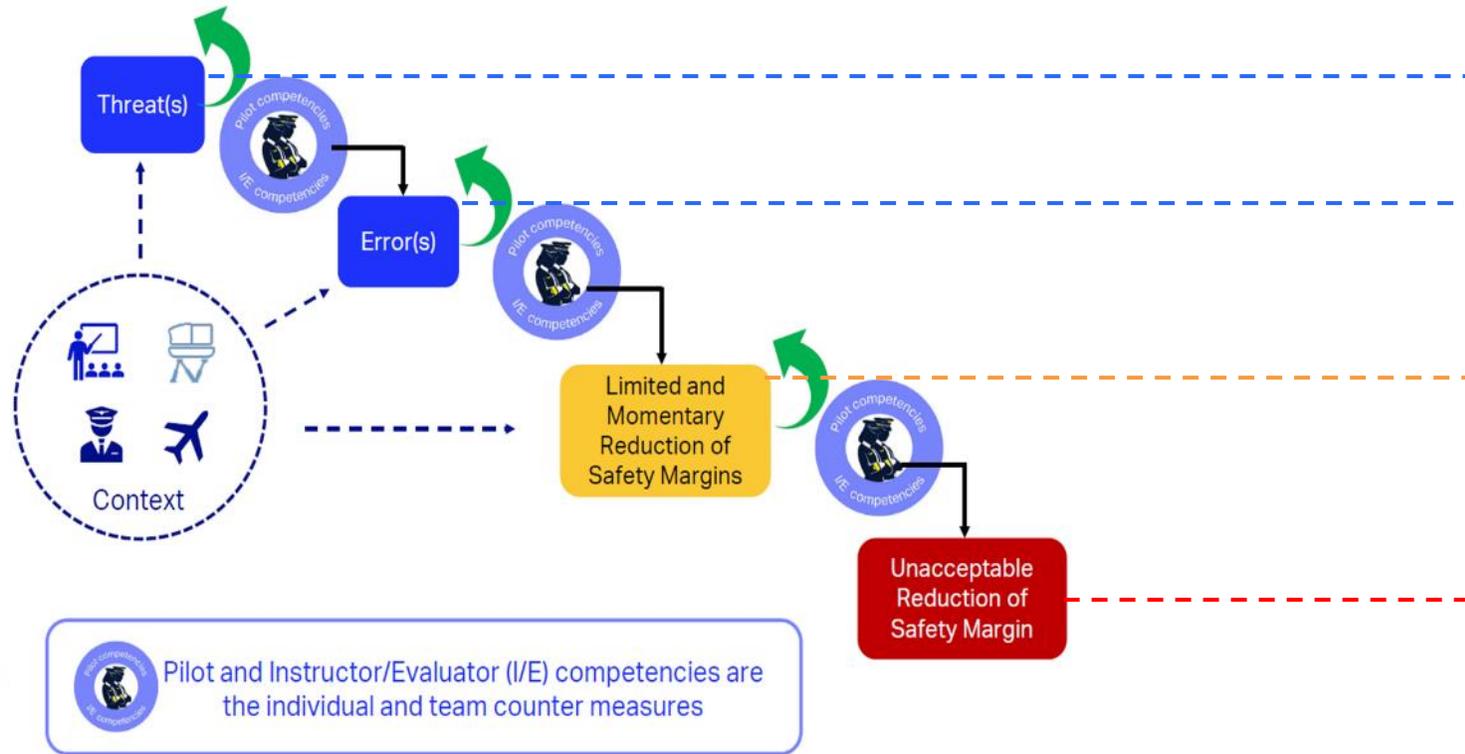
# Simulation of “Subtle” and/or “Highly Improbable” scenarios accelerates the development of “relevant” experience.

Unforeseen events are the daily lot of pilots, and not the exception.

- Changes in atmospheric conditions affecting aircraft energy.
- Systems failures which are not declared by the internal warning systems.
- Failure to Capture Altitude, LOC, GS, NAV.
- Erroneous G/S.
- Erroneous LOC capture.
- False G/S .
- Thrust Management Computer improper thrust settings; Does not respond to thrust targets, no failure indication.
- GPS jamming.

The FSTD is more than a type rating tool – it is a competency development environment.

# Use simulator telemetry to reduce Instructor Workload

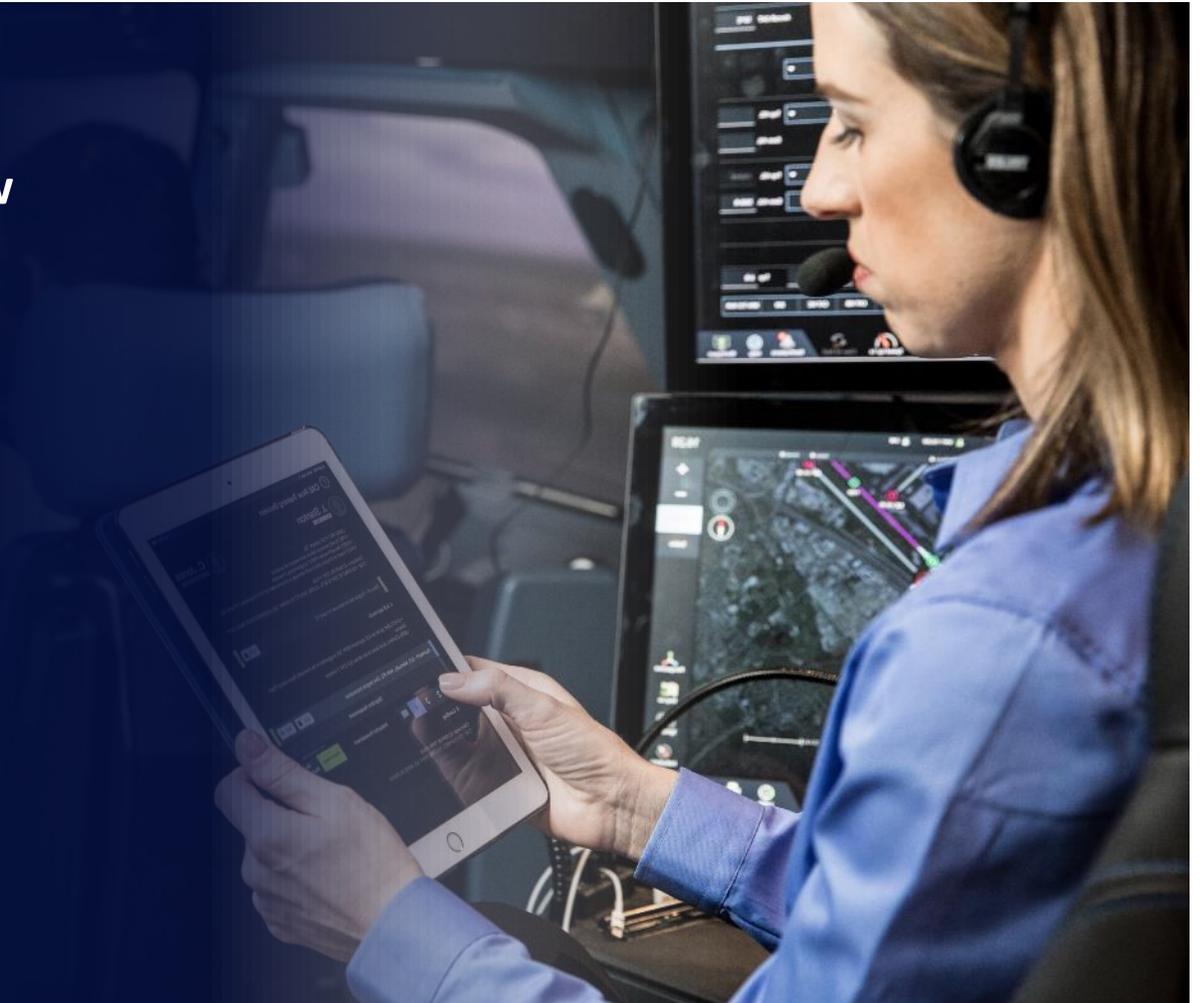


Use Technology to capture Threats, Errors and Safety Margin exceedances– allowing the Instructor to focus on the Crew Behaviors required to Evaluate Pilot Competence.

# Use gaze tracking to supplement instructor observation

The instructor's seating position in a simulator does not allow them to **effectively evaluate crew behaviours that address:**

- **Active monitoring,**
- **Cross-checking, and**
- **Effective scan patterns**



One can use simulator telemetry and biometric data to mitigate these challenges.

# Biometrics + Telemetry assist the instructor during training



General Pilot  
Monitoring  
behaviour



General scan patterns.



Gaze transition on  
landing (from in to out)



Flare  
behaviour



Cognitive  
workload

# Measuring competence in the context of the landing maneuver

## Measures of Process

- Flare initiation height
- Flare amplitude/frequency (technique)
- CW position, Rudder pedal deflection
- Thrust reduction (technique)
- Gaze entropy
- Gaze Transition from in to out

## Measures of Outcome

- Vertical Deviation from flight path
- Touchdown location
- Vertical speed evolution
- Actual Landing Distance achieved
- Lateral Deviation

Telemetry data

Biometric data

Measure both Process and Outcome in varying conditions – compared to “Gold Standard”

# Measuring competence in the context of the landing maneuver

## Benchmark against “expert” pilot performance in “real world” conditions:

- Repeatable landing/flare scan pattern, transfer of gaze from inside to outside, visual aiming point,
- Consistent correlation of motor skills (flare technique) with gaze.



# Assessing effective monitoring?

## What behaviours should be observed?

### **Observable behaviours relevant to effective monitoring:**

OB 1.5 Monitors aircraft systems status.

OB 3.2 Monitors and detects deviations from the intended flight path and takes appropriate action.

OB 3.4 Maintains the intended flight path during flight using automation while managing other tasks and distractions.

OB 4.5 Maintains the intended flight path during manual flight while managing other tasks and distractions.

OB 3.6 Effectively monitors automation, including engagement and automatic mode transitions.\*

OB 6.2 Seeks accurate and adequate information from appropriate sources.

OB 6.7 Monitors, reviews and adapts decisions as required.

OB 7.1 Monitors and assesses the state of the aeroplane and its systems.

OB 7.2 Monitors and assesses the aeroplane's energy state, and its anticipated flight path.

OB 7.3 Monitors and assesses the general environment as it may affect the operation.

OB 8.7 Monitors, reviews and cross-checks actions conscientiously.\*

OB 8.8 Verifies that tasks are completed to the expected outcome.

\*Some behaviours are difficult to observe from the simulator instructor operating station.

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\*Behaviours that may be “observed” using biometric data (gaze tracking).

# Use Gaze tracking to supplement Instructor observation

CAE Rise Training Event Viewer

Training Event

Crew Member 1: Capt / PM  
Crew Member 2: FO / PF

PHASES: PRE / TAXI, TO, CLB, CRZ, DES, APP, LDG, POST

TEM

APP: Engine Fire Drill  
MAL: R ENG FIRE | ILS Approach - WSSS RWY 02L

CAE Rise Training Event Viewer

Engine Fire Drill PHASES APP

Crew Member 1: Capt / PM  
Crew Member 2: FO / PF

Workload Focal

Timeline: 14:27, 14:28, 14:29, 14:30, 14:31, 14:32, 14:33, 14:34

SITUATION

Crosswind (left):	9 kt	RVR:	3045m	OEI:	Yes
Tailwind:	5 kt	Weight:	138141 LB	VAPP:	145 kt

MALFUNCTIONS

- Engine Seizure (L)
- Engine Fire (L)

INSIGHTS

14:27:05	Master Warning	disconnection
14:28:00	A/T ARM Switch	Confirm Off
14:29:19	Thrust Lever	Confirm Idle
14:30:25	FUEL Control Switch	Confirm Cut Off
		PF OBSERVED   PM OBSERVED
14:31:45	Engine Fire Switch	Confirm Pull
14:32:12	Fire Bottle 1	Off
14:23:25	Fire Bottle 2	Off

Higher than expected focus on ND



Confirmation of gaze

Technology to support Risk Based Training Programs

The collection and analysis of  
accurate training data

# Accurate grading data is required to drive accurate insights.



## EASA Guidance for Mixed EBT Implementation - Item 5.2

“The competent authority is invited to **verify if the operator has a system (including procedures) to ensure the accuracy of the grading system**, this system provides a reasonable root cause analysis when there is a mismatch, and sensible corrected actions are established in such case.”

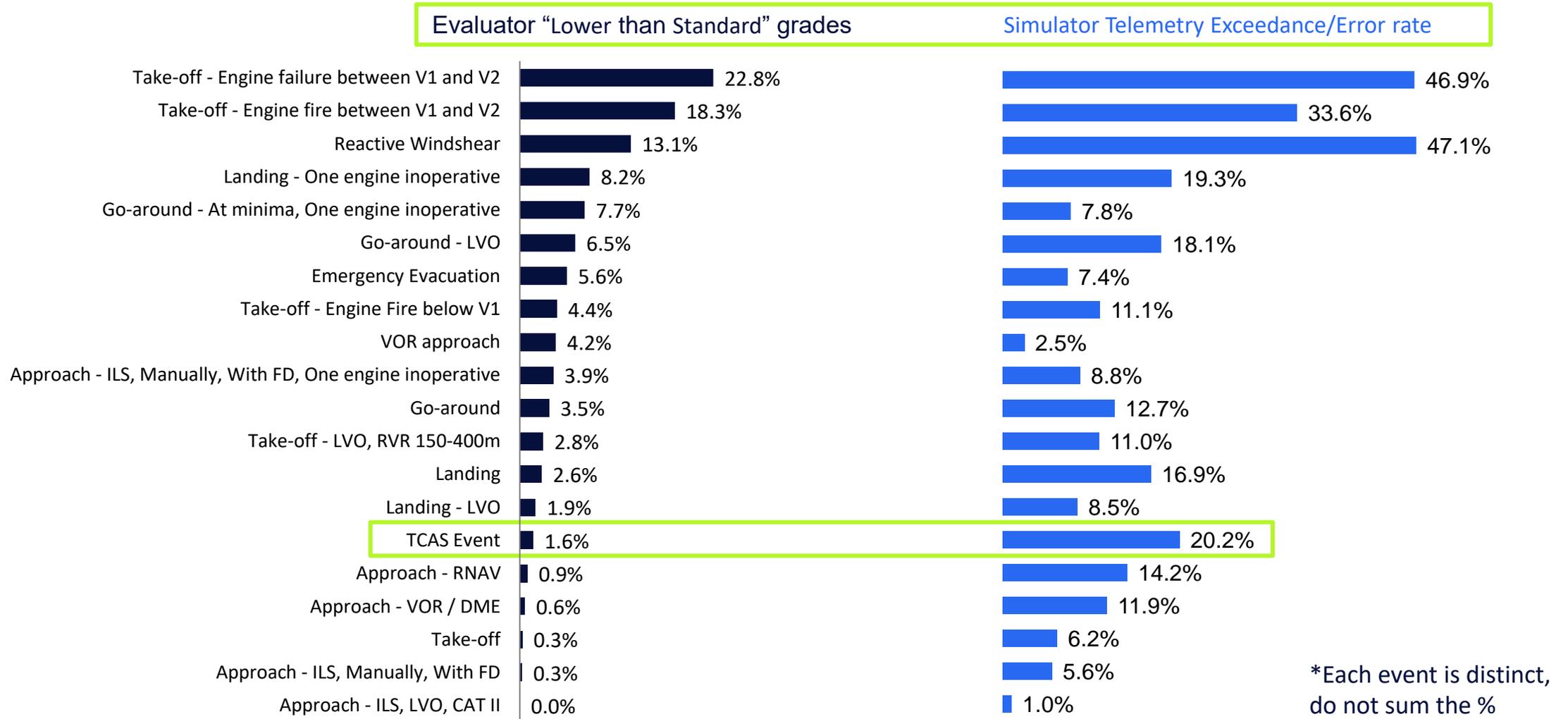
## Advanced Qualification Program FAA AC120-54A - 5.7

“A standardization program is necessary to establish uniform grading criteria, address reliability between instructors/evaluators, and develop remediation procedures. **The AQP data collection and analysis is incumbent upon reliable and valid instructor/evaluator grading judgments.**”



Agreement among instructors and accuracy of grading overall, are equally important.

# Evaluator grades vs. simulator telemetry data



Comparison from independent sources can provide increased confidence of grading data quality.

# Benchmark data

## Landings

All Landings

Telemetry

Grading

Aircraft Type

Training Program

Analysis Time Frame

A320

All Programs

All Cycles

All Filters

Crosswind: No filter

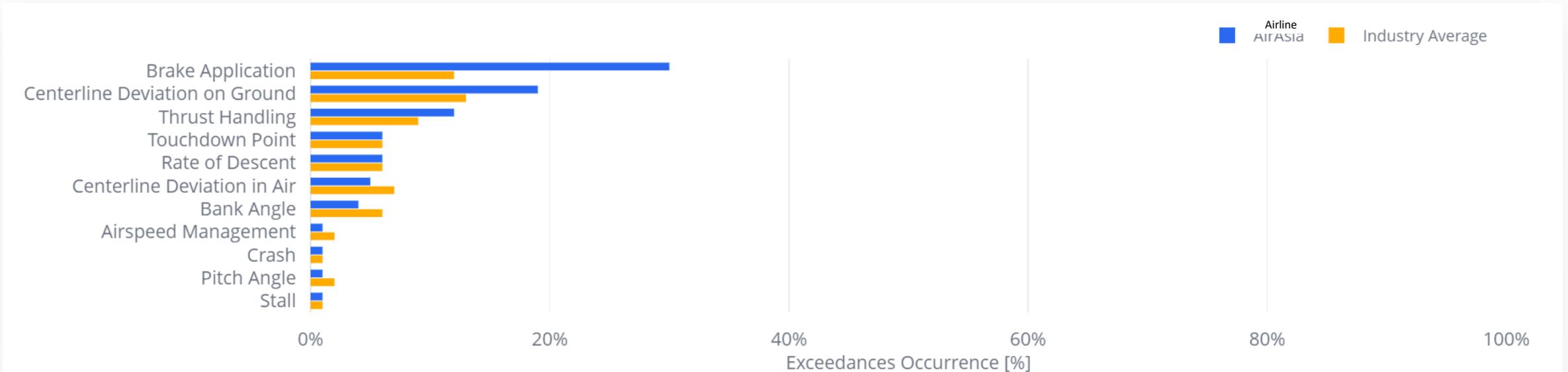
RVR: No filter

Flap/Slat Fault: No filter

Engines: No filter

## Training Event Elements

Shows only top 5 elements



Feedback

# Proactive/Predictive Safety Management Partnership

Reactive	Reactive/Proactive	Proactive	Proactive/Predictive
<p>E.g. Analysis Accident-Incidents</p>	<p>E.g. Analysis of event including Undesired Aircraft States</p>	<p>E.g. Analysis of Threat and Error Management</p>	<p>E.g. Analysis of CBTA -EBT Training metrics (Grading/Telemetry/Biometric data)</p>
	<div data-bbox="639 622 924 1125"> <p>Flight Data Analysis (FDA)</p>  <p>Mandatory Occurrence reporting</p>  </div>	<div data-bbox="1166 622 1439 1125"> <p>Line Oriented Safety Audits (LOSA)</p>  <p>Voluntary Safety reporting</p>  </div>	<p>TEM Model for Training, Licensing and Operations</p> 

Source: IATA whitepaper

# EASA data for safety initiative

## D4S membership and expansion status (March 2024)



### Air Operators

- British Airways\*
- EasyJet\*
- Iberia\*
- KLM\*
- Ryanair\*
- Vueling\*
- 1) Aer Lingus
- 2) Norwegian
- 3) TAP (Portugal)
- 4) Wizz Air
- 5) Edelweiss Air
- 6) Luxair
- 7) TUI Fly (Belgium)
- 8) HOP!



### EASA MSs

- Ireland\*
- France\*
- Spain\*
- 1) Belgium
- 2) Bulgaria
- 3) Croatia
- 4) Denmark
- 5) Finland
- 6) Italy
- 7) Luxembourg
- 8) Netherlands
- 9) Norway
- 10) Portugal
- 11) Romania
- 12) Slovenia



### ATM

- 1) Airnav Ireland
- 2) Austro Control
- 3) Eurocontrol MUAC\*
- 4) DFS
- 5) DSNA\*
- 6) ENAIRE
- 7) ENAV
- 8) SKYGUIDE



### OEMs

- Airbus\*
- Boeing\*



### Aviation Professional Representatives

- ECA\*
- IFATCA

Alignment on inclusion of training data : bridging safety insights from operations & training.

# Summary

## Risk Based Training

- Reducing Experience levels.
- A training response to accelerate the acquisition of relevant experience.

## Supporting Technology

- AI to simulate real time ATC. (voice and digital)
- Simulation of “Subtle” and/or “Highly Improbable” scenarios.
- Telemetry to capture error, exceedances.
- Biometrics to supplement instructor observations.

## Using Training Data

- Data 4 Safety evolution.
- Data use challenges:
  - Data acquisition and ownership.
  - Data integrity, security, privacy and compliance .
- We need to work together:
  - Unions, OEMs, Operators, ATOs, Regulators, and pilots

Use existing and emerging technology to optimize risk-based training programs.



# Thank you!

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Commercial Aviation Training

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