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WELCOME
09/06/2015

The role of **Flight Data Analysis** in the aircraft manufacturer's **SMS**.

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The role of Flight Data Analysis in the aircraft manufacturer’s SMS

SMS – Safety Management System

Information: Why and What

AIM – Aircraft Integrity Monitoring

How **define** what to be monitored at AIM?

AIM **Results**

SMS
Safety Management System

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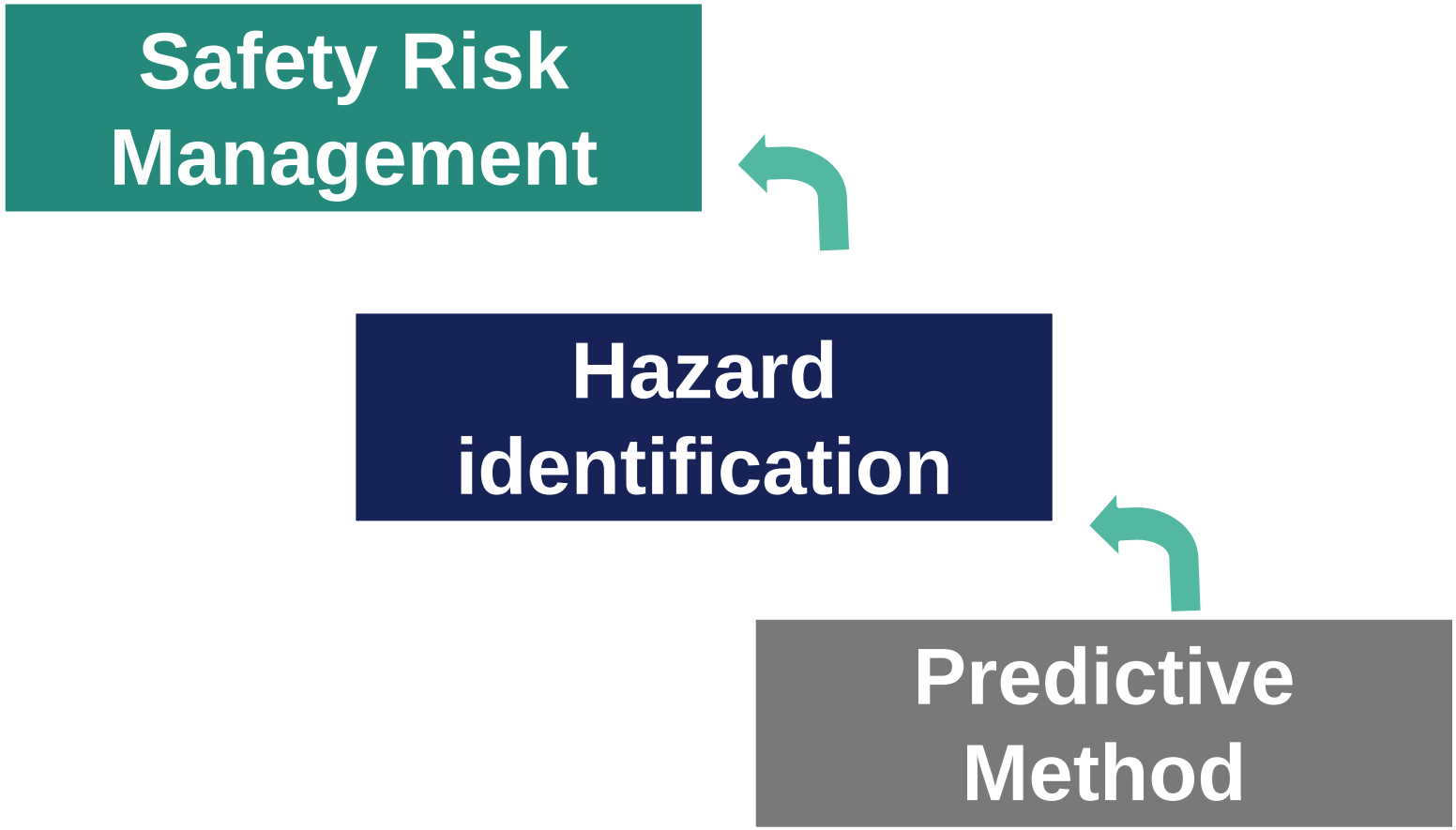
Embraer SMS

Embraer SMS is an explicit element of the corporate management system that sets out the company's safety policy and defines how it intends to manage safety as an integral part of its overall business.

Embraer SMS Pillars

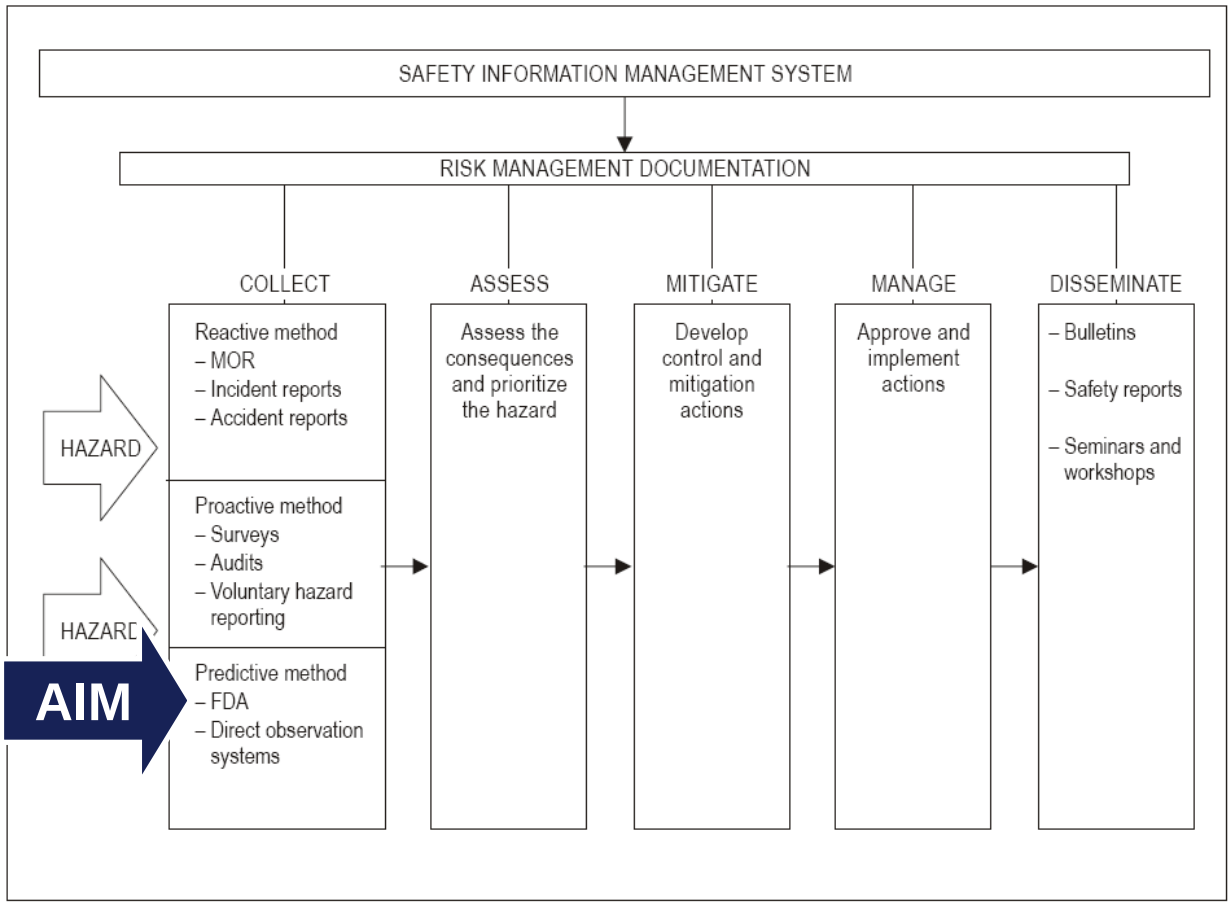
SMS Manual - ENS-005776

Safety Risk Management



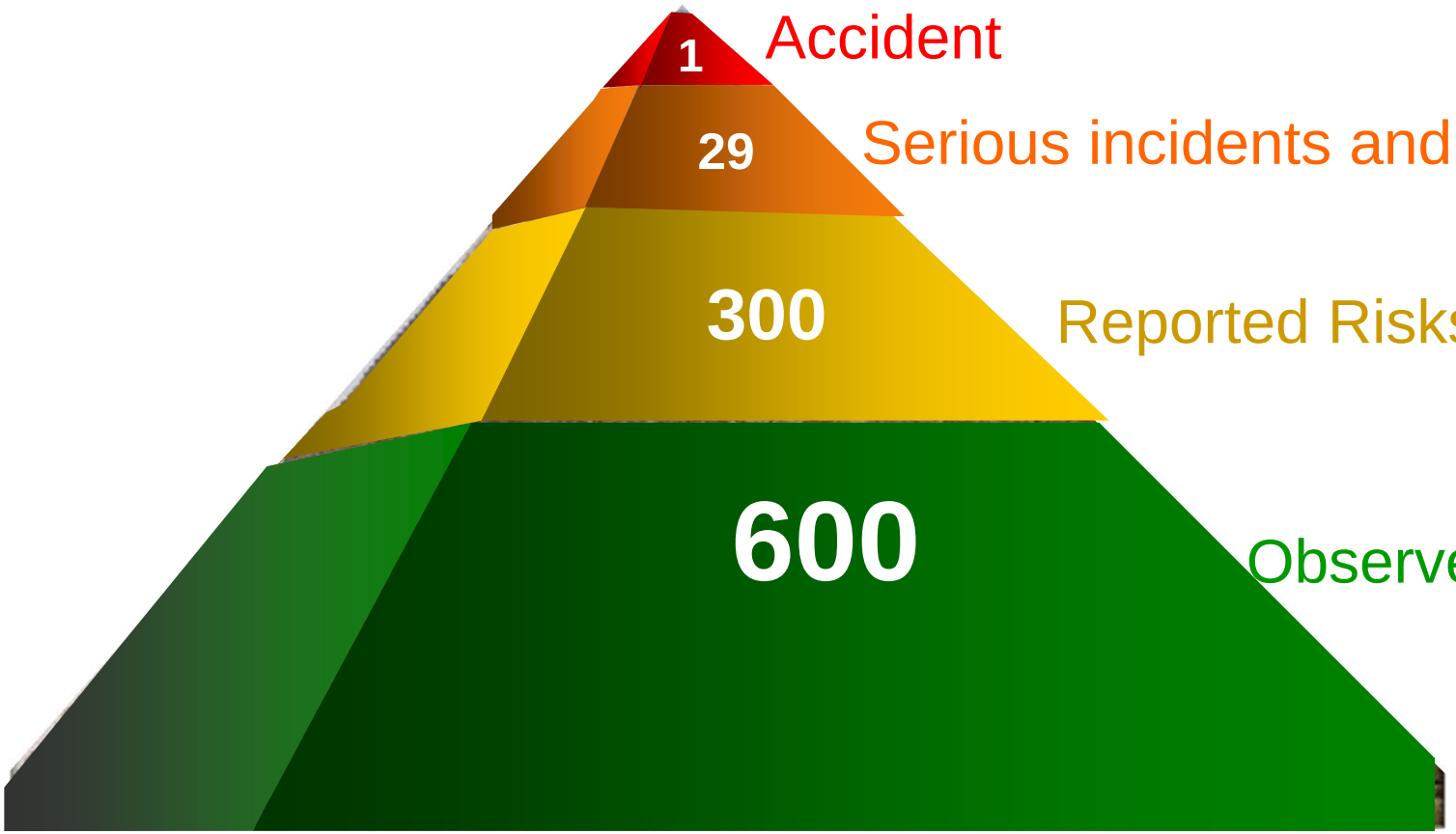
SMS ICAO (Doc. 9859 – Cap 5.3.43 Safety Risk Management).

Hazard documentation and follow-up management process



SMS ICAO (Doc. 9859 – Figure 5-3 Hazard documentation and follow-up management process.

The Heinrich / Bird Theory



Information:
Why and What

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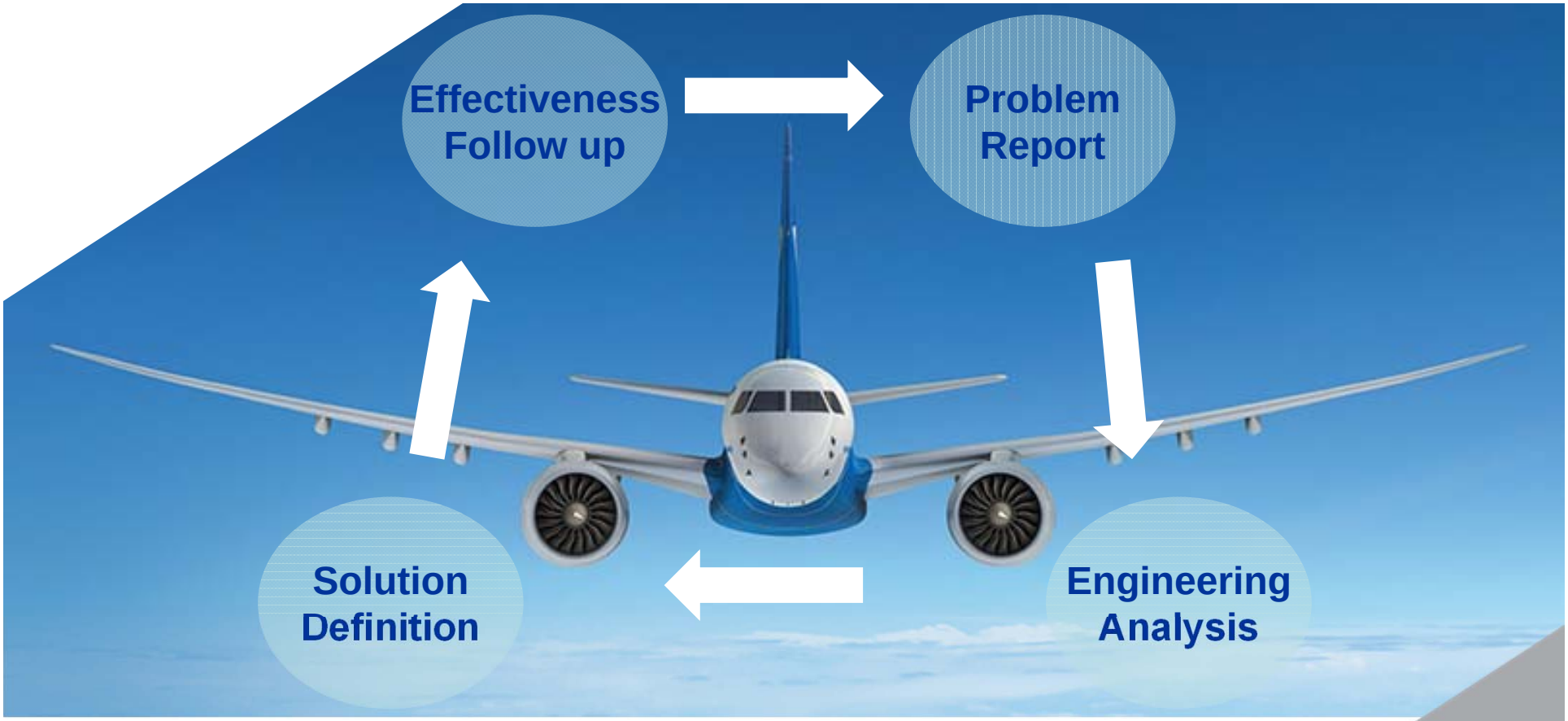
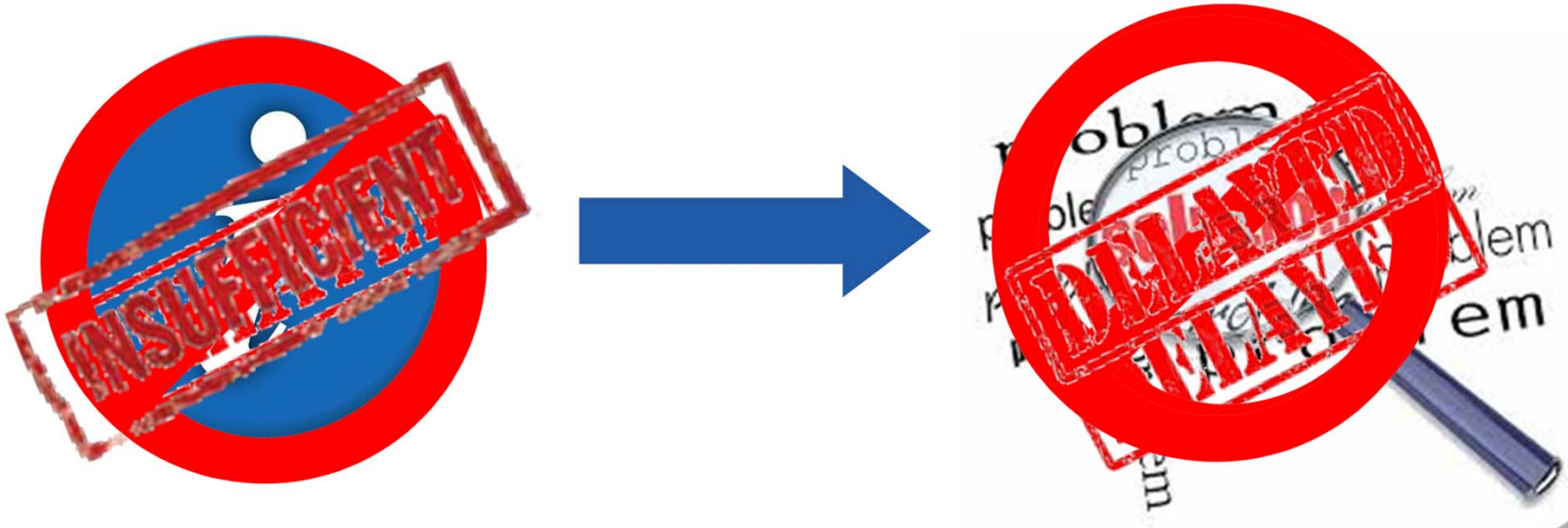
The Closing the Loop concept for SMS



Information: Why and What

The **data** from the field is the basis of the in-service difficulty solution process.

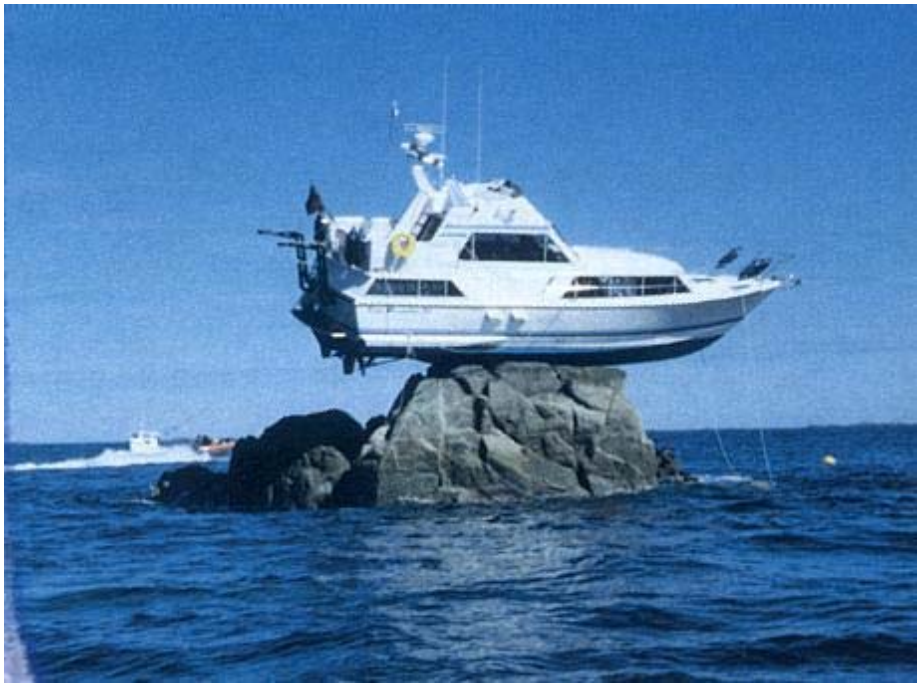


Is the product working as expected?

The responsibility of an aircraft manufacturer on product safety continues after the aircraft delivery

Product Monitoring needs to know :
Is the product working as expected ?

Lack of data from the field



Lack of data is a safety issue !!

Where to get more data to produce relevant information?

Unknown Risk

Why flight data is so important?

- **Aircraft systems complexity**
- **On-board software – How to investigate ?**
- **Need of precise and factual data**
- **Time-history of the aircraft behaviour**
- **Factual information to the parts supplier.**

AIRCRAFT INTEGRITY MONITORING

AIM
Aircraft Integrity Monitoring

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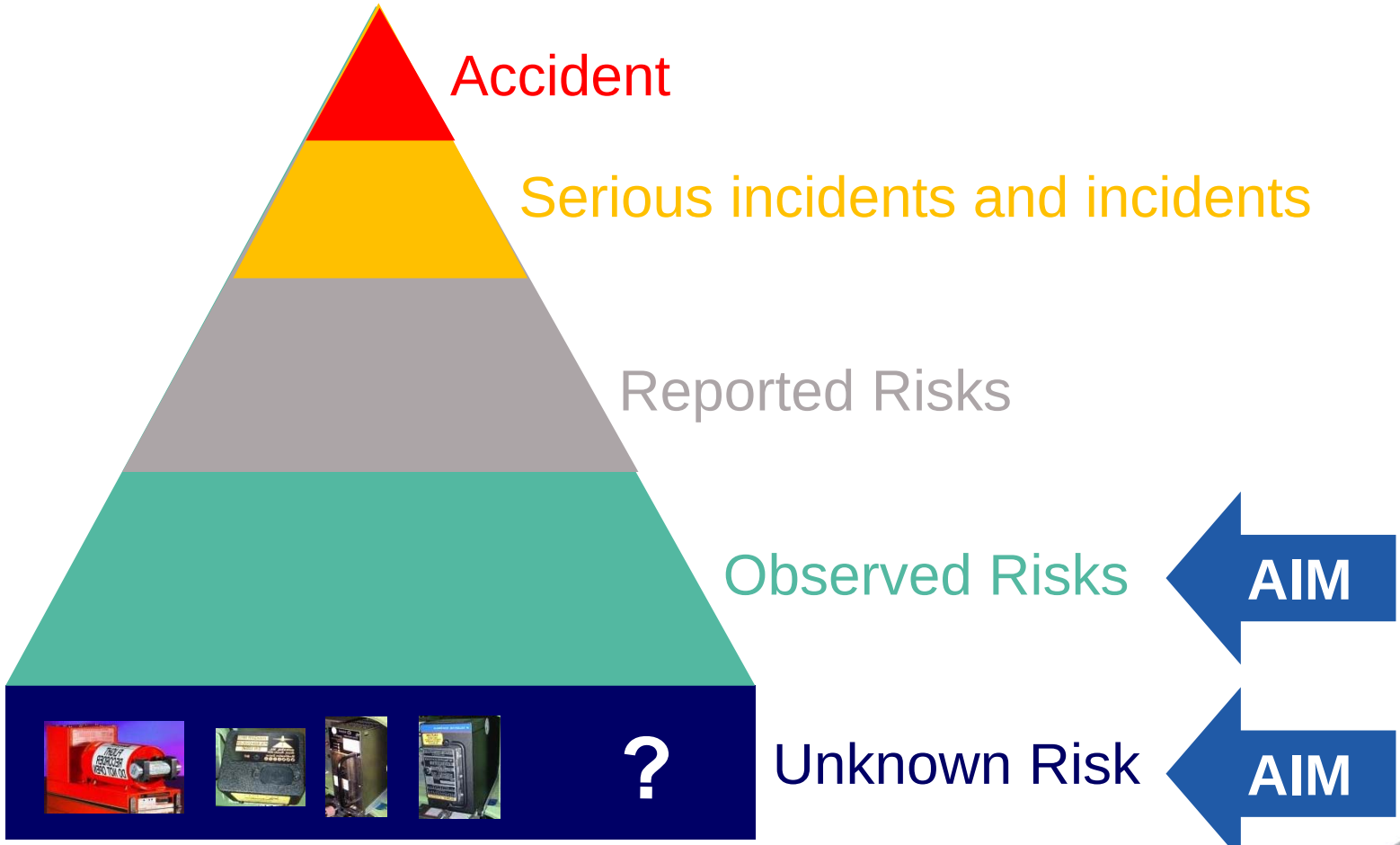
Where the AIM works?



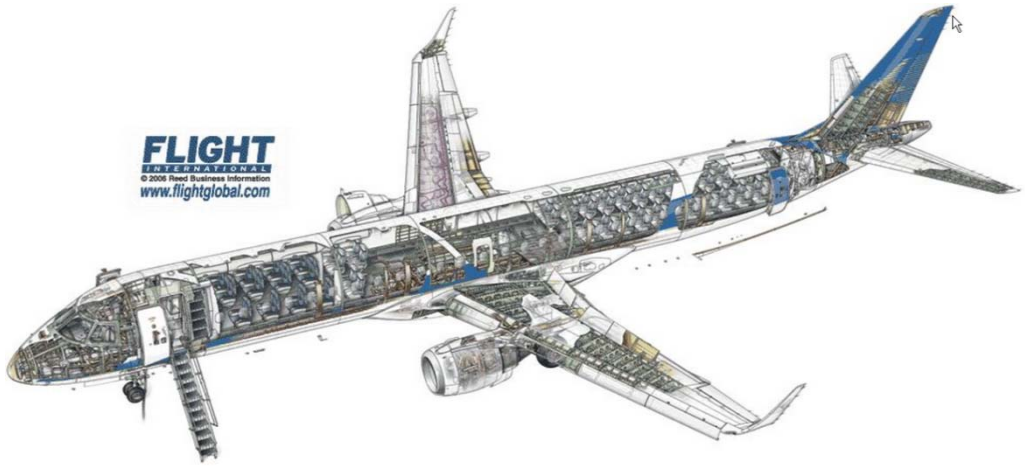
What is AIM?

• The AIM is a program for routine in-flight recorded data analysis to detect abnormal on-board systems conditions and/or adverse trends.

• The AIM also has the goal to support and enhance the process of the in-service technical difficulties investigation and follow up the effectiveness of the respective Embraer corrective actions.

• The source of data for AIM can be FDR/QAR.

AIM – Aircraft Integrity Monitoring



Aircraft systems performance

In-service technical difficulties solutions

Voluntary participations

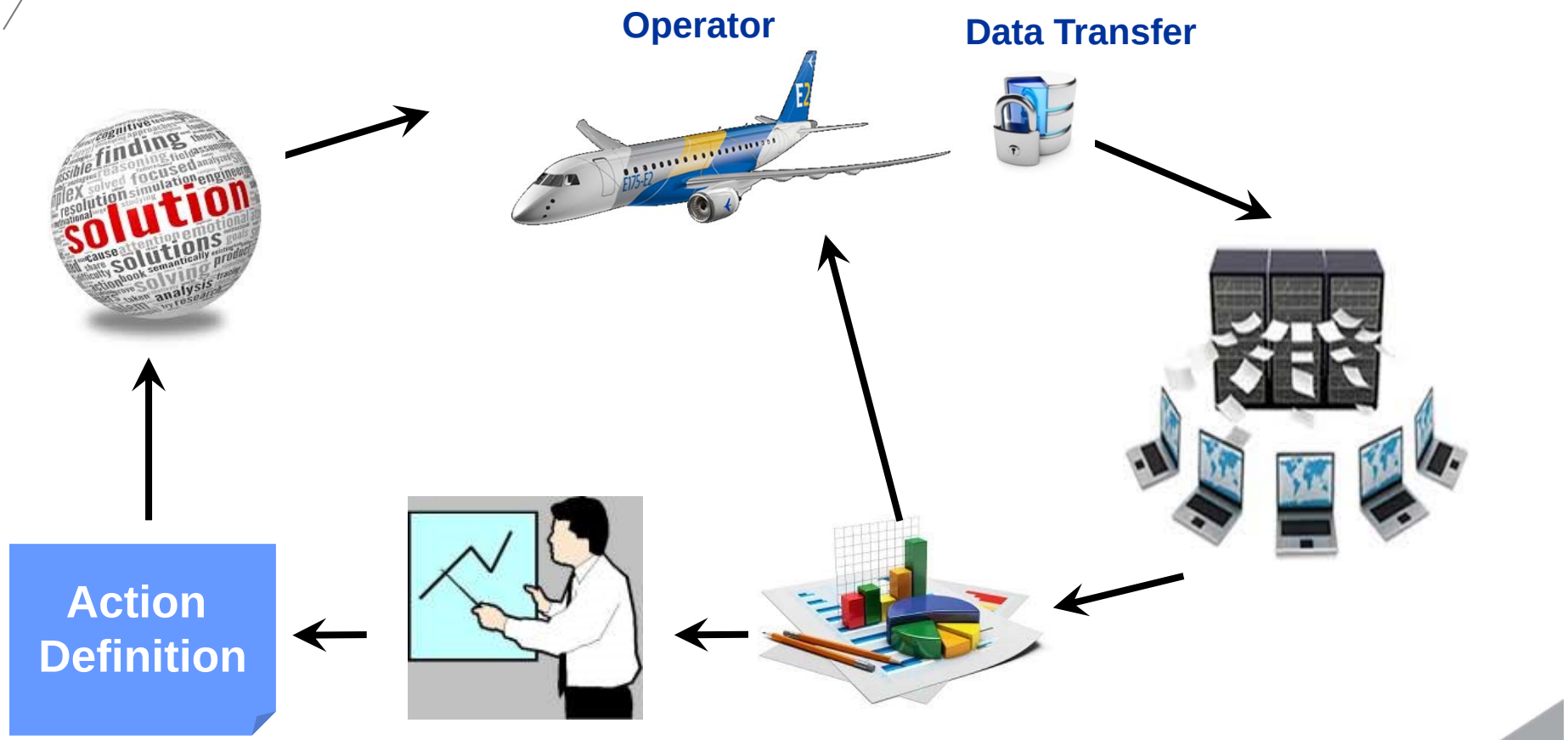
AIM is not FOQA

Aircraft Integrity Monitoring **is not** FOQA

The AIM does not have the goal to detect or identify operational deviations or to monitor the flight crew performance.

AIM is construed in a manufacturer-to-operator non disclosure agreement and its scope is to enhance safety.
AIM is protected to be used against any disciplinary action to a crew member.

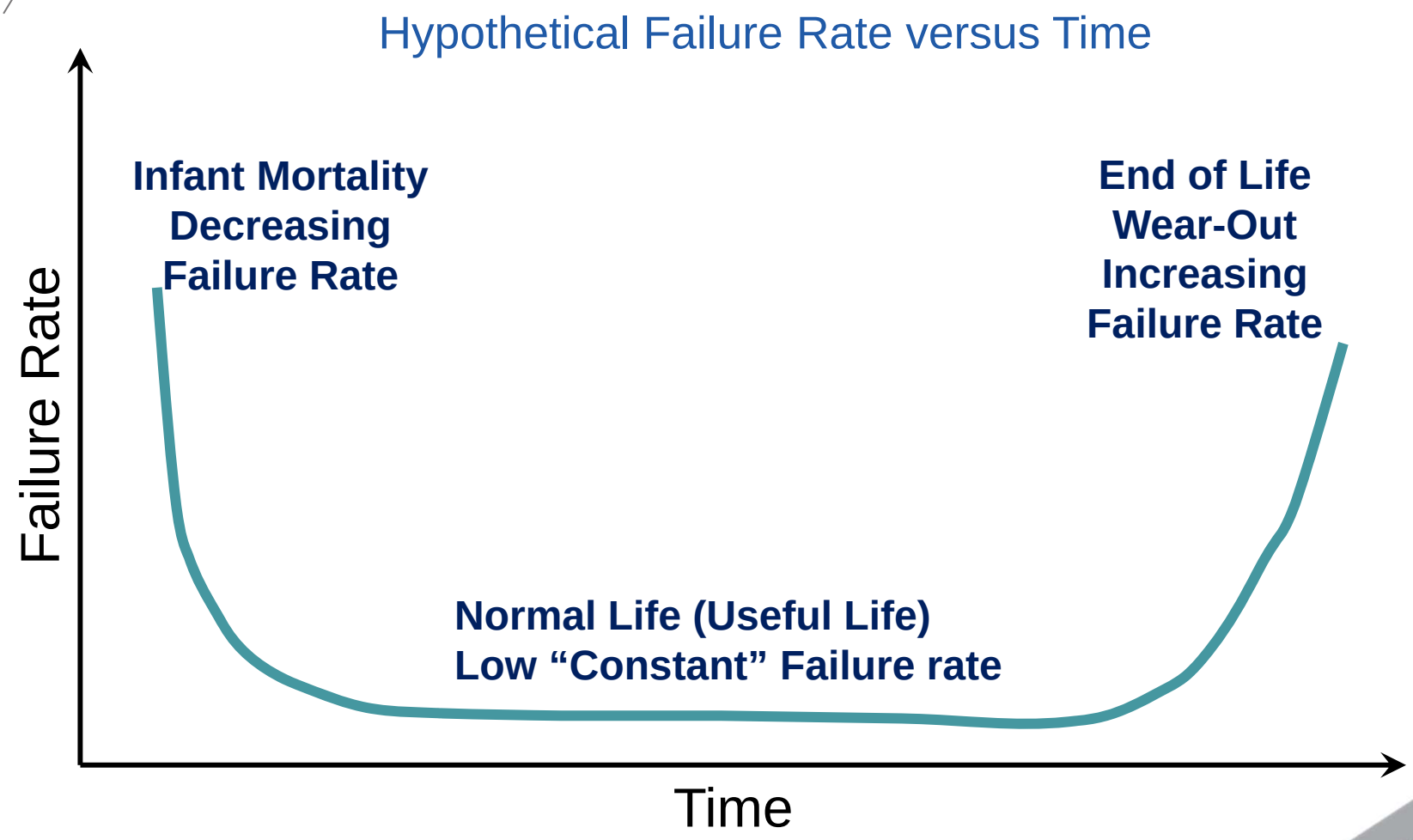
AIM Process



Why to monitor the aircraft integrity ?

Need to know what is not apparent to the manufacturer

The Bathtub curve



TC – Type Certificate – a continuous compromise

United States of America

Department of Transportation

Federal Aviation Administration

AIRCRAFT

Type Certificate

IMPORT

Number A56NM

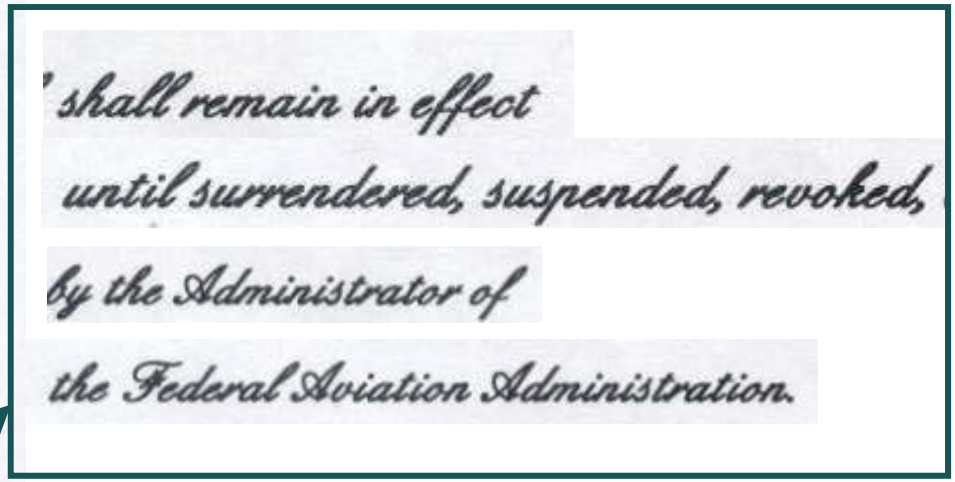
This certificate, issued to **EMBRAER – Empresa Brasileria de Aeronautics, S/A,** certifies that the type design for the following product with the operating limitations and conditions therefore as specified in the Federal Aviation Regulations and the Type Certificate Data Sheet, meets the airworthiness requirements of Part 25 of the Federal Aviation Regulations.

Models ERJ 170-100 STD and ERJ 170-100 LR

This certificate, and the Type Certificate Data Sheet which is a part hereof, shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

Date of application: May 20, 1999

Date of issuance: February 20, 2004 Models ERJ 170-100 STD and ERJ 170-100 LR



Importance of flight data in a pilot's report

Example of Pilot's report:

"Aircraft failed to capture ILS"

Report

Embraer engineering analysis:

Altitude= ?
Airspeed= ?
Trajectory= ?
Auto Pilot Mode= ?
Bank Angle= ?

Avionics Manufacturer:

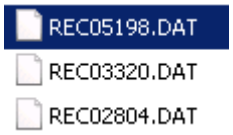
?

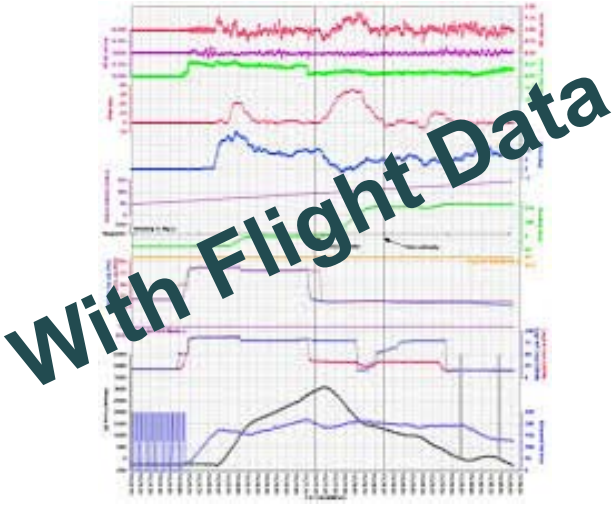
Importance of flight data in a pilot's report

Example of Pilot's report:
"Aircraft failed to capture ILS"

Report

Flight Data



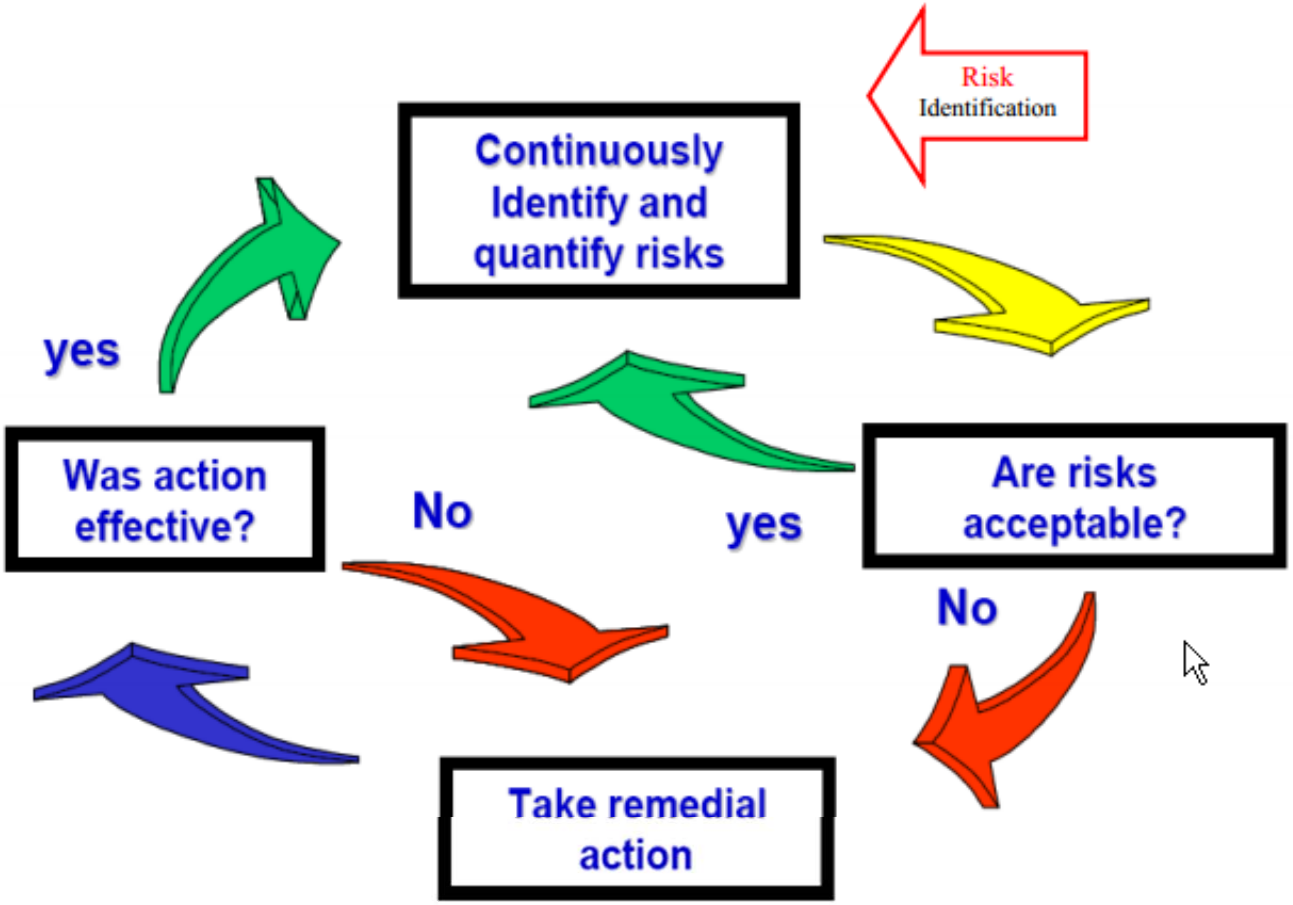


Embraer engineering analysis:

Altitude = 4100 feet
Airspeed = 210 knots
Trajectory = Correct
Auto Pilot Mode = Approach
Bank Angle = 20 degrees

Avionics Manufacturer: Action

Why to monitor the aircraft integrity ?




How define
what to be monitored at AIM?
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How define what to monitor at AIM?

Product Monitoring Engineers

Engineers / Customers

Issue

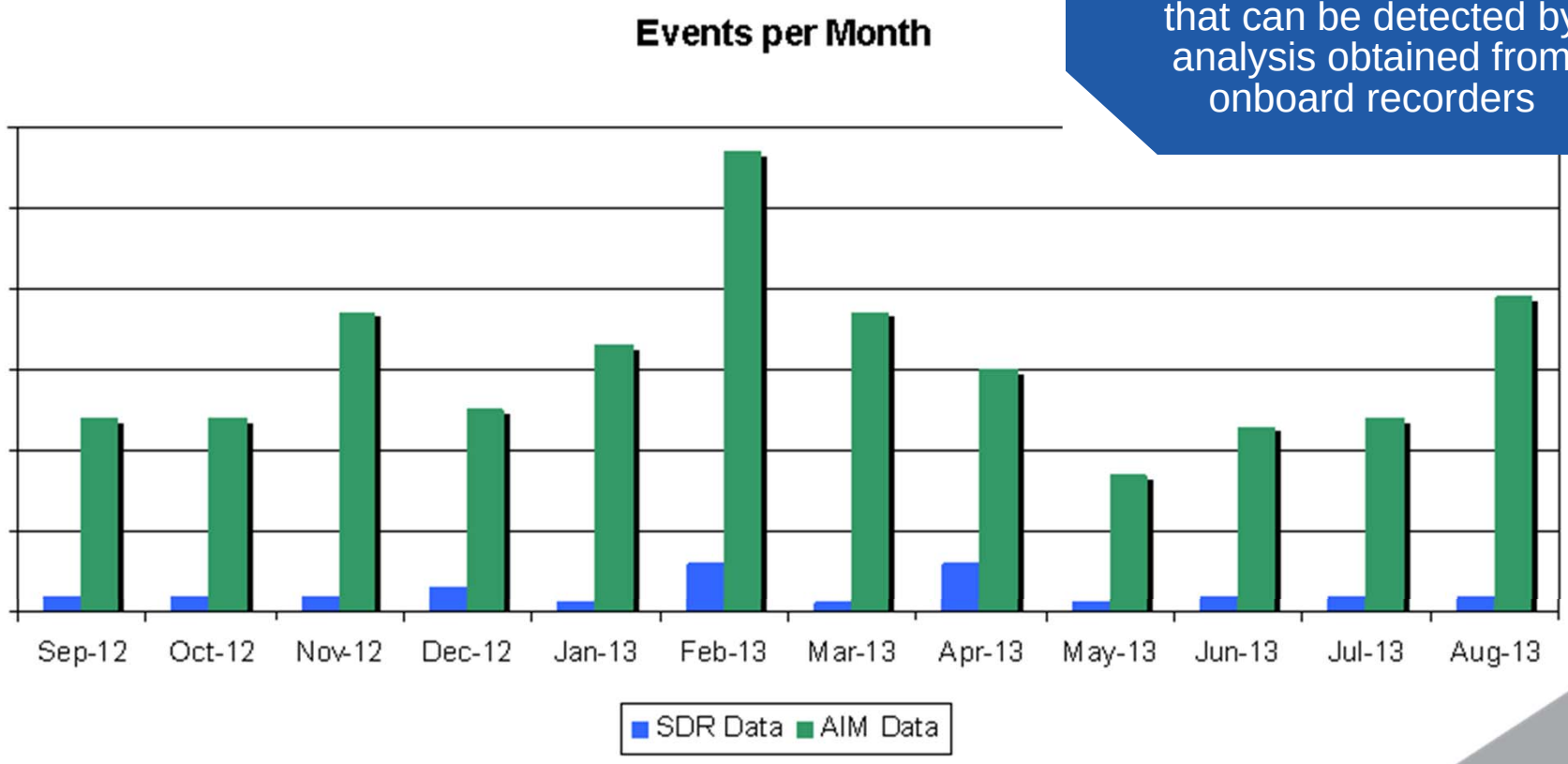
Example of some logics

- UHT (Uncommanded Hight Thrust)
- Uncommanded IFSD
- Loss of DC BUS
- Display Monitoring
- RAT System Monitoring
- Slat Fail
- Ice Detection Fail
- Bleed Leak Detect
- Bleed Fail

AIM Results

Report of “Slat Fail” EICAS message

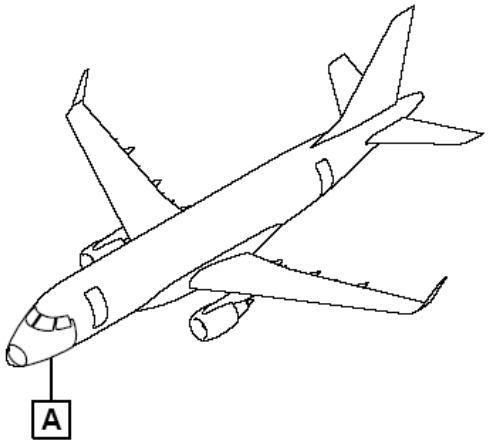
EVENT
Any fault, failure or abnormal aircraft system behaviour that can be detected by analysis obtained from onboard recorders

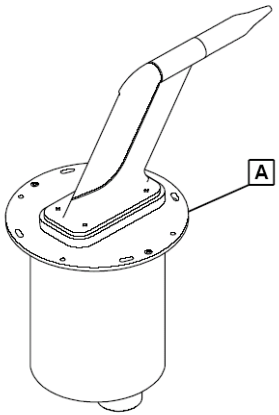


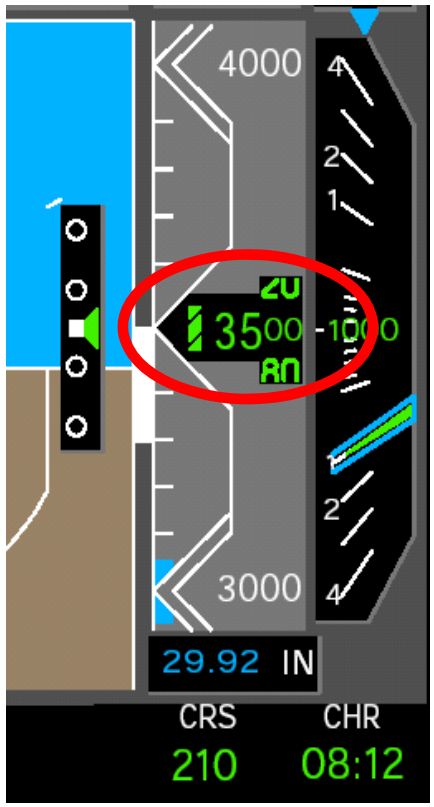
Issue: Altitude Indication

Difference of the indicated altitude between pilot and copilot out of the tolerance

Action : Correction in the Static Source Error Correction (SSEC) table. Smart Probe -7A (SB 170-34-0009)

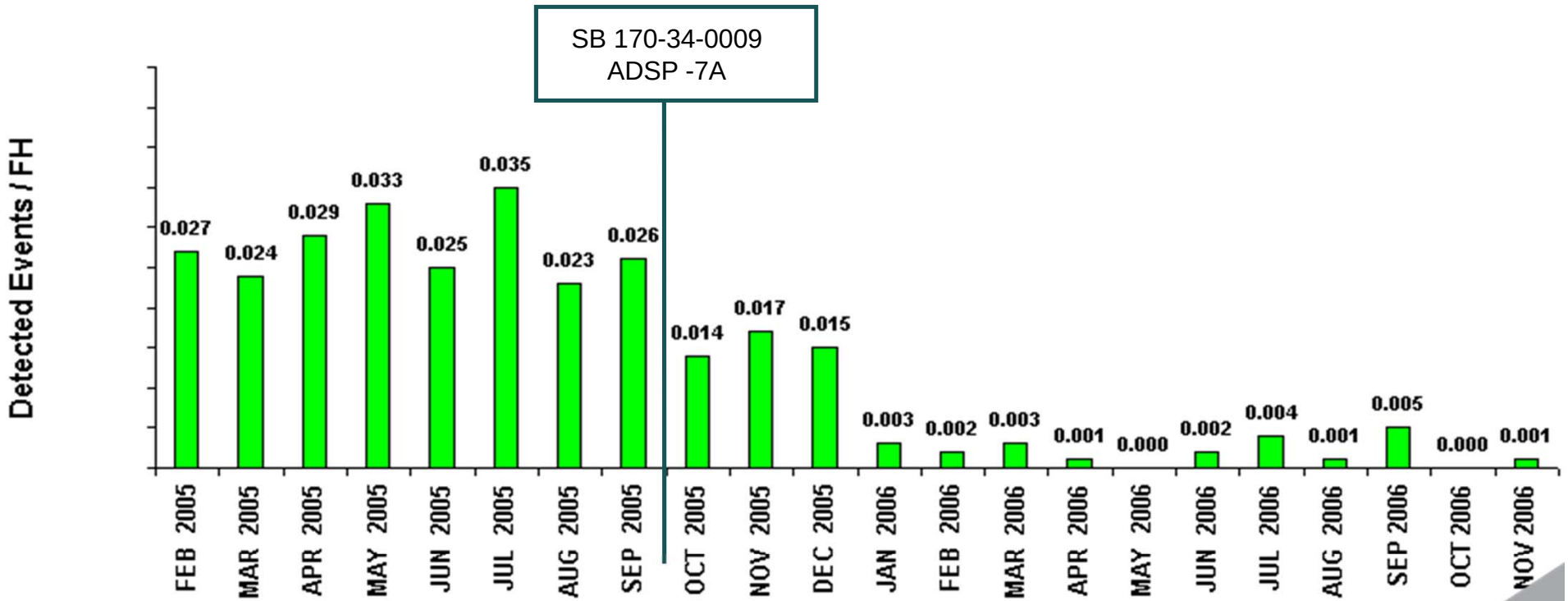






Issue: Altitude Indication – SB 170-34-0009

Difference of the indicated altitude between pilot and copilot out of the tolerance
Action: Smart Probe Software Change (-7A) – SB 170-34-0009 issued on 30.Sep.2005



Hard Landing

A hard landing is a high energy runway contact. The NTSB defines hard landing as "stalling onto or flying into a runway or other intended landing area with abnormal high vertical speed"

Is Hard Landing a FOQA event?

Operational

Aircraft

Hard Landing analysis

Parameters involved in HL analysis

- Vertical CG Acceleration (NormAccel)
- Pitch Angle (Pitch)
- Air/Ground indication (Air/Gnd)
- Gross Weight (GrossWeight)
- Roll (Roll)
- Date (Day)
- Destination Airport

Hard Landing analysis – AMM 2012

MAINTENANCE MANUAL

Table 601 - CG ACCELERATION THRESHOLD

GROSS WEIGHT	CG ACCELERATION THRESHOLD
29,500 kg to 32,300 kg (65,036 lb to 71,209 lb)	2.3 g
32,300 kg to 36,000 kg (71,209 lb to 79,366 lb)	2.2 g
36,000 kg to 39,000 kg (79,366 lb to 85,980 lb)	2.1 g
39,000 kg to 42,300 kg (85,980 lb to 93,255 lb)	2.0 g
42,300 kg to 47,000 kg (93,255 lb to 103,617 lb)	1.9 g
47,000 kg to 51,800 kg (103,617 lb to 114,199lb)	1.8 g

(e) If the vertical CG acceleration peak

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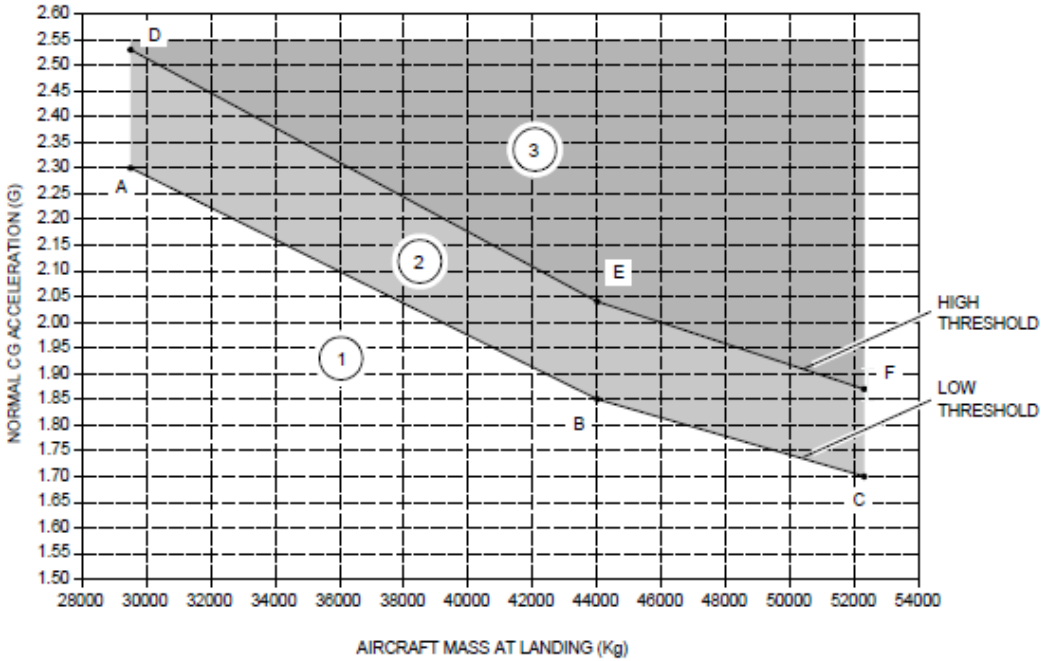
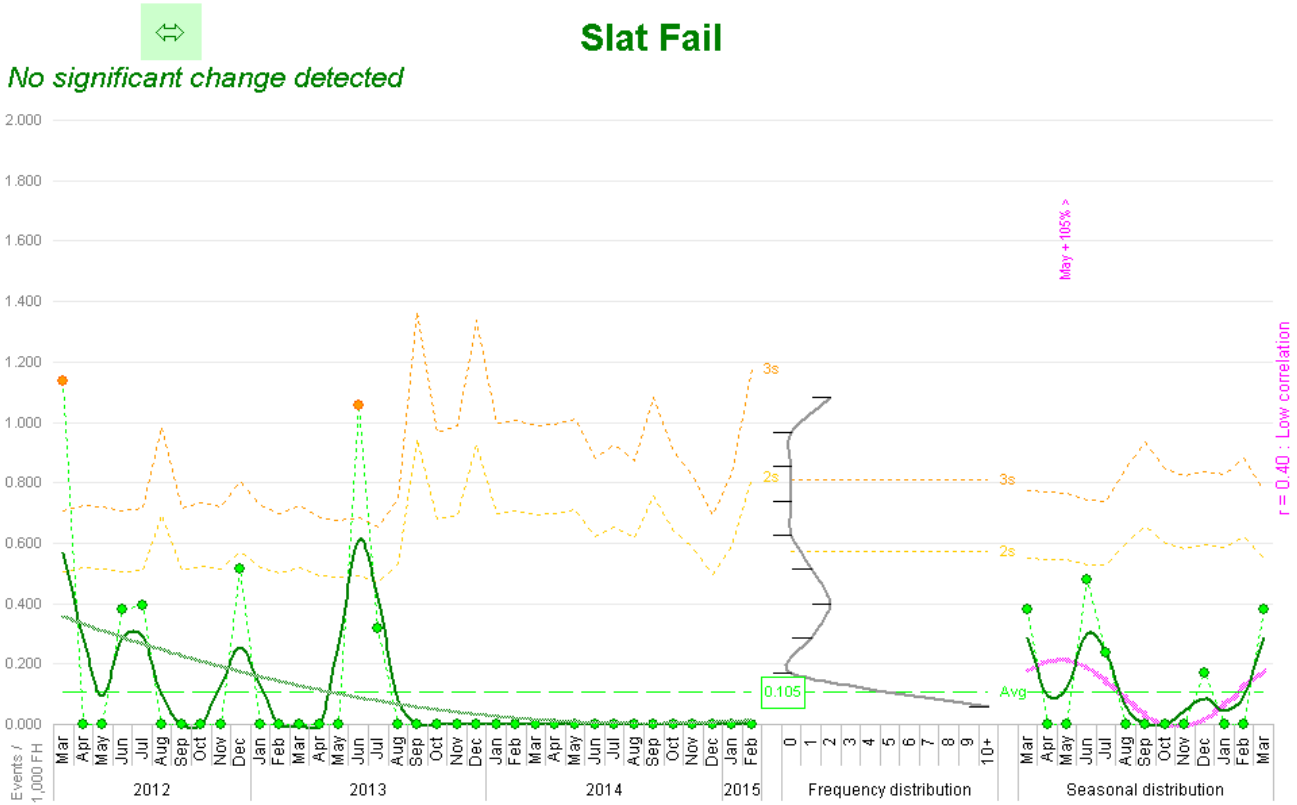
Hard Landing analysis – AMM 2013



		AIRCRAFT MASS AT LANDING (Kg)	NORMAL CG ACCELERATION (G)
LOW THRESHOLD	A	29,500	2,30
	B	44,000	1,85
	C	52,290	1,70
HIGH THRESHOLD	D	29,500	2,53
	E	44,000	2,04
	F	52,290	1,87

Reports to Customer

Periodically, Airlines that have the AIM agreements receive a report with the statistics of the main issues monitored by AIM Embraer.



AIM Outputs

- Systems abnormal behavior analysis
- Systems performance analysis
- Abnormal event analysis
- Periodic statistical summary
- Parameter exceedance monitoring.

AIM Results

- In some cases, helps to improve the logics from customers
- Helps to improve and validate some maintenance procedures at AMM
- Detection of non reported events
- Dataframe Validation
- Helps the development of new aircraft
- Analysis for workshops in Ice conditions
- Detect minor events
- Check a Service Bulletin effectiveness.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