Xavier Jolivet
Director of Flight Safety

David Zwegers
Regional Safety Director
Latin America & Caribbean

Airbus support to incident/accident investigations

AIG Lima 18-20 March 2014

Ref. 420.1066/14

Content

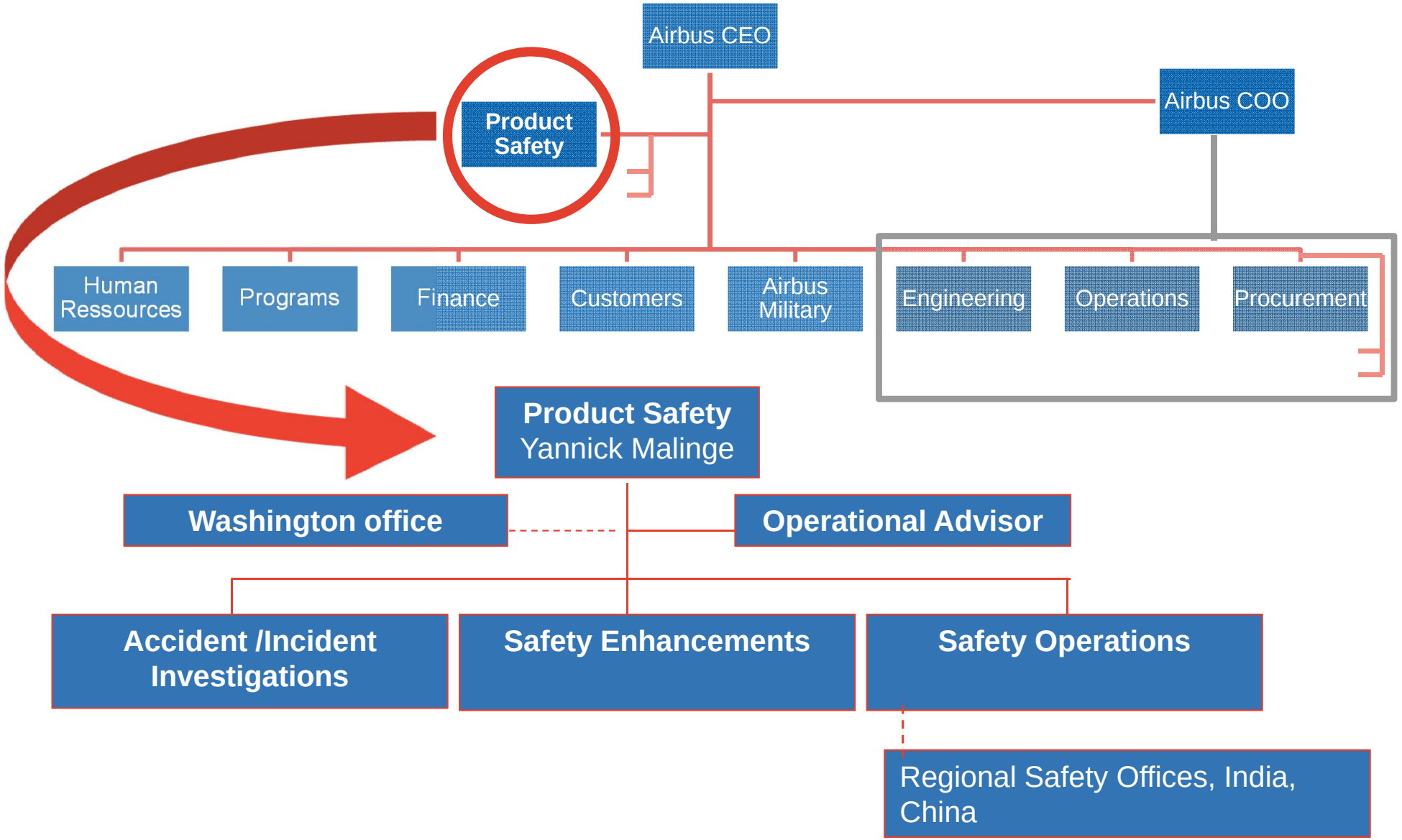
- **Familiarization with the Airbus world**
- Immediate response to accident
- Over the duration of an investigation
- Investigation reports
- Event reporting
- Views on regional cooperation
- Conclusion

Permanent support adapted to the context

- Airbus acts as technical advisor to the state of aircraft manufacture, in respect to the ICAO annex 13 investigation rules
- Airbus commits in supporting you in your duty to investigate accident and incidents:
  - In anticipation, familiarization to the Airbus world
  - In response to crisis, immediate support
  - Continuous technical and operational support over the duration of an investigation
- The sooner you involve us, the sooner we can assist you

AIRBUS

Product safety within Airbus



Flight safety investigators

- Airbus Flight Safety Investigators

Head of Investigations

Frédéric Combes
Head of Investigations

Accident Incident Investigators

Nicolas Bardou

Xavier Barriola

Panxika Charalambides

Denis Cadoux

Thomas Lepagnot

Jean Daney

Xavier Jolivet

Thierry Thoreau

Albert Urdiroz

- account.safety@airbus.com
- Airbus Flight Safety hot line +33 (0)6 29 80 86 66

AIRBUS

Familiarization to Airbus Civil products

- 4 civil aircraft families
  - A300 A310 A300-600
  - A318 A319 A320 A321
  - A330 A340
  - A380
- Future A350 family
- Continuous development
  - Structure
  - Systems
  - Powerplants

By end January 2014

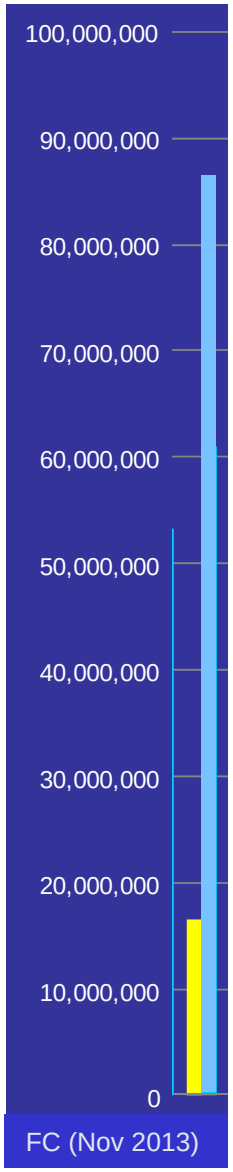
- 13820 orders
- 8295 delivered
- 7660 in operation
  - 415 WB
  - 5723 SA
  - 1399 LR
  - 123 DD
- 390 operators

An Airbus is taking-off every 2 seconds

AIRBUS

Familiarization to Airbus products

- A300 (1974)
  - 1st Airbus into service
- A310 & A300-600 (1983)
  - Introduction of
    - Glass cockpit
    - FMS equipped A/C
- A318/A319/A320/A321 (1988)
  - Fly by wire (FBW)
  - Flight envelope protection
- A330/A340 (1993)
- A380 (2007)

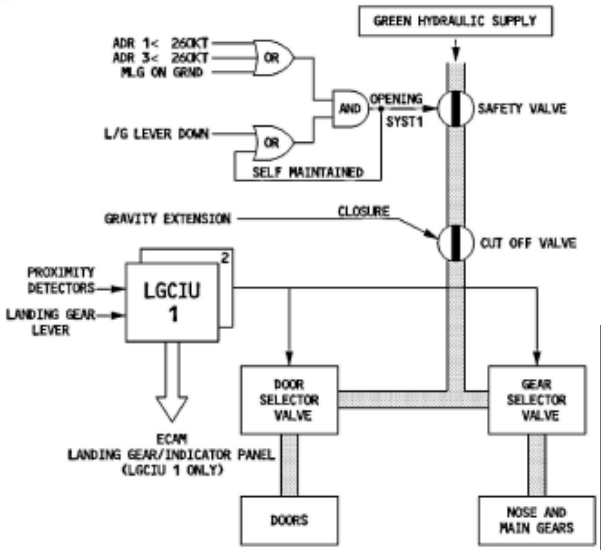


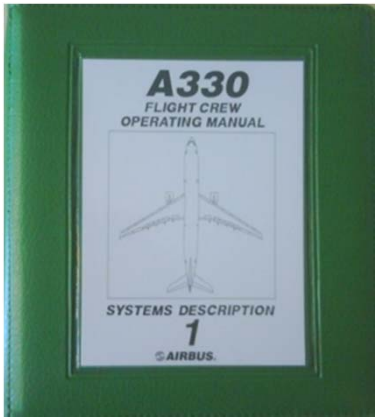
Airbus FBW aircraft
188 Million Flight Hours since EIS
86 Million Flight Cycles since EIS

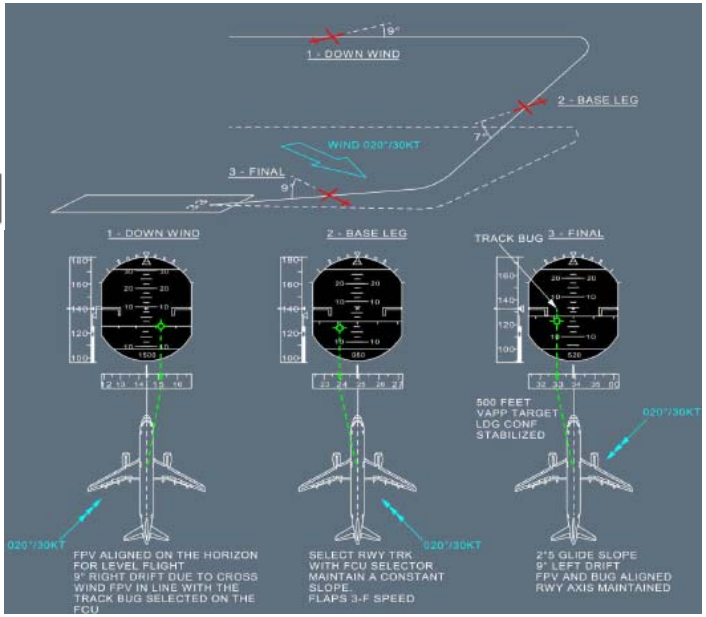
A300/A310/A300-600
34 Million Flight Hours since EIS
17 Million Flight Cycles since EIS

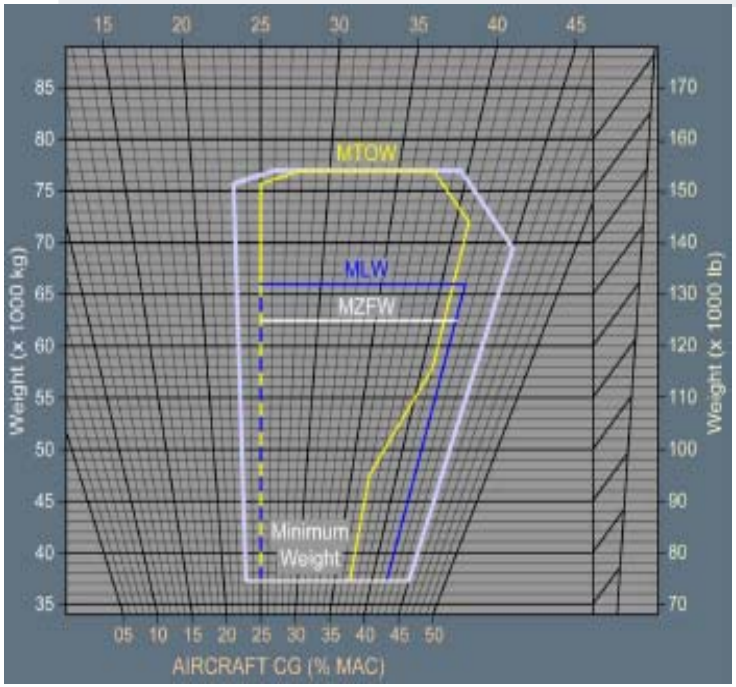
Familiarization to Airbus products

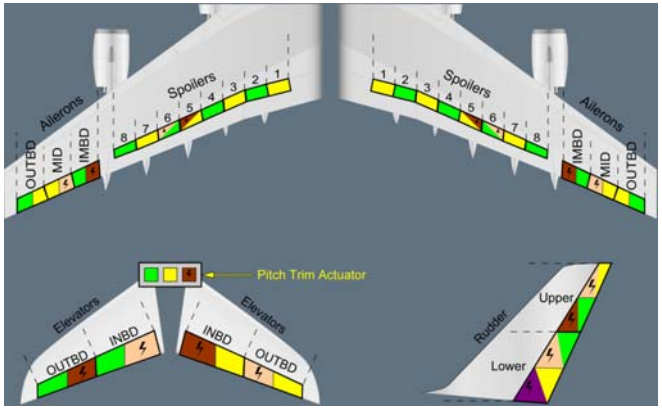
- General familiarization courses are available to gather basic knowledge on the Airbus aircraft families











Familiarization to Airbus products

- You may register to *Safety first*, the Airbus safety magazine
  - Aims at enhancing safe flight through increased knowledge and communication about safety topics
  - Source of safety information
    - For the use of flight and ground crew members who fly and maintain Airbus aircraft
    - For other selected organizations, such as Investigation Boards
  - Material obtained from multiple domains
    - Various Airbus Departments
    - Airline industry
    - Government agencies
    - Other aviation sources

AIRBUS

Safety first

- Includes selected information from incident and accident investigation reports, system tests and flight tests

A320/ Runway overrun

Lars KORNSTAEDT
Robert LIGNEE

Operational Landing Distances
A new standard for in-flight landing
nce assessment

David OWENS

The Go Around Procedure

Stéphane BOISSENIN
Elisabeth SALAVY

A320 Family/ Evolution of ground spoiler logic

FCTL chec
after EFCS
on ground

By: Kristjof TRITSCHLER
Flight Safety Manager
Germanwings

Albert URD
Flight Safety
Airbus

Jacques ROSAY

What is stall? How a pilot should react in front of a stall situation

Compliance to Operational Procedures

Why do well trained and experienced pilots not always follow procedures?

By: Claire Pelegrin
Director Human Factors

Jacques CHAVAGNE
Mechanical Instructor
Airbus Training Center
Customer Services

Oxygen safety

The Take-Off Securing function

Uwe EGGERLING
Safety Director
Engineering & Maintenance
Customer Services

By: Stéphane PUIC
Project Leader, Safe
Engineering

Xavier JOLIVET
Director, Flight Safety

Stéphane RAMON
Head of Repair & System, Nacelles
Engineering Support
Customer Support

Preventing Fan Cowl Door Loss

Claude LELAIE

Minimum control speed tests on A380

Do not forget that you are not alone in Maintenance

Safety first

- Address your requests and queries to Airbus Flight Safety
  - account.safety@airbus.com
- Register *Safety first* magazine
  - marie-josee.escoubas@airbus.com

Safety first The Airbus Safety Magazine

Subscription Form
To be sent back to

AIRBUS FLIGHT SAFETY OFFICE
Fax: 33 (0)5 61 93 44 29
Mail to:marie-josee.escoubas@airbus.com

Name .....
Surname .....
Job title/Function .....
Company/Organization .....
Address .....
.....
.....
Post/Zip Code .....
Country .....
Telephone .....
Cell phone .....
Fax .....
E-mail .....
(Mandatory for both digital and paper copies)

Please send me the digital copy* ☐
Please send me the paper copy* ☐ (Please note that paper copies will only be forwarded to professional addresses)

* Please tick the appropriate case

AIRBUS

Content

- Familiarization with the Airbus world
- **Immediate response to accident**
- Over the duration of an investigation
- Investigation reports
- Event reporting
- Views on regional cooperation
- Conclusion

Response to crisis

- Airbus Flight Safety hot line
  - +33 (0)6 29 80 86 66

- Activation of the Crisis Control Centre
  - Dedicated line to Investigation Boards
  - Your Single Point of Contact within Airbus
  - 24/7 availability
  - Full confidentiality
  - Accessible to only who needs to know

- 4 CCCs:
  - Toulouse (manage all events)
  - Washington, Beijing (activated as relevant)
  - Madrid (activated in relation with military aircraft events)

AIRBUS

Immediate Response - Airbus investigator team

Airbus Lead Investigator (ALI)

- The ALI is selected from the Airbus Flight Safety Department (investigation group)
- The ALI follows the investigation from the first day till the end

☞ ***The ALI is the focal point for the investigation board***

Go-team dispatch

Go Team (for on-site investigation):

- A team of experts on standby
  - ✓**A**irbus **L**ead **I**nvestigator
  - ✓Systems specialist
  - ✓Structure specialist
  - ✓Engine specialist

- Yearly specific medical check-up
- Trained to investigation techniques and practices
- Investigation equipments and documentation ready

Immediate measures

- Save manuals valid at the date of occurrence, e.g.
  - Operations
    - FCOM Flight Crew Operating Manual
    - QRH Quick Reference Handbook
    - AFM Airplane Flight Manual
    - MEL Minimum Equipment List…
  - Maintenance & engineering
    - AMM Aircraft Maintenance Manual
    - SRM Structure Repair Manual
    - IPC Illustrated Part Catalogue
    - AWM Aircraft Wiring Manual…
- Save manufacturing and in-service records

Immediate measures

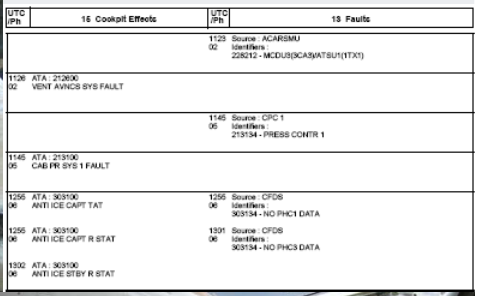
- Investigators safety
  - Accident sites are dangerous
  - Airbus can help the IIC by providing appropriate warnings
    - Call attention to materials, active systems, aircraft securing to avoid injury or death to persons
    - E.g., pressurized systems, oxygen bottles, hydraulic fluids, risk of fire, landing gear lockage, hot components, stressed structures…

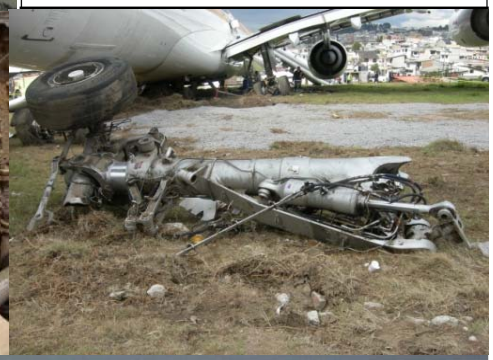
Immediate measures

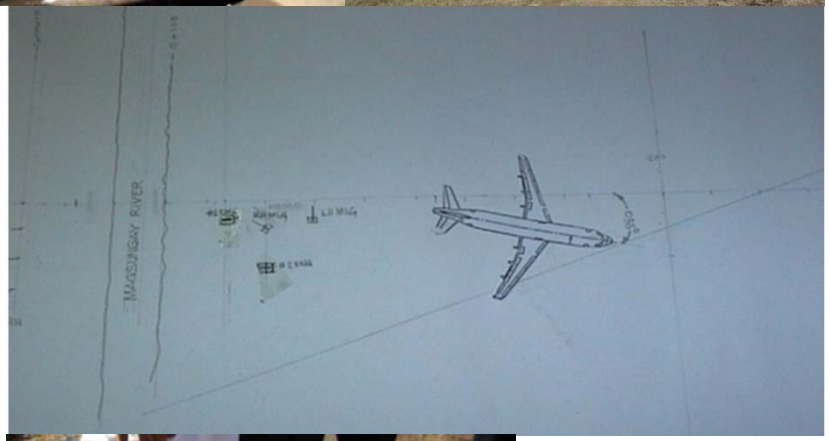
- Prevent loosing or disturbing evidences
  - E.g. Structure condition at impact / mapping, preservation of fracture surfaces, preservation of volatile materials, securing of computers memories…

At incident / accident site

- Retrieve DFDR & CVR
- Retrieve additional recorders
- Retrieve Non-Volatile-Memories
  - BITE's, Post Flight Report…
- Record aircraft configuration
  - Document conditions possibly modified upon aircraft impact, recovery…
- Anticipate on future investigation needs
  - Contribute to mapping in order to support trajectory & performance studies
  - Quarantine equipments for future lab investigation



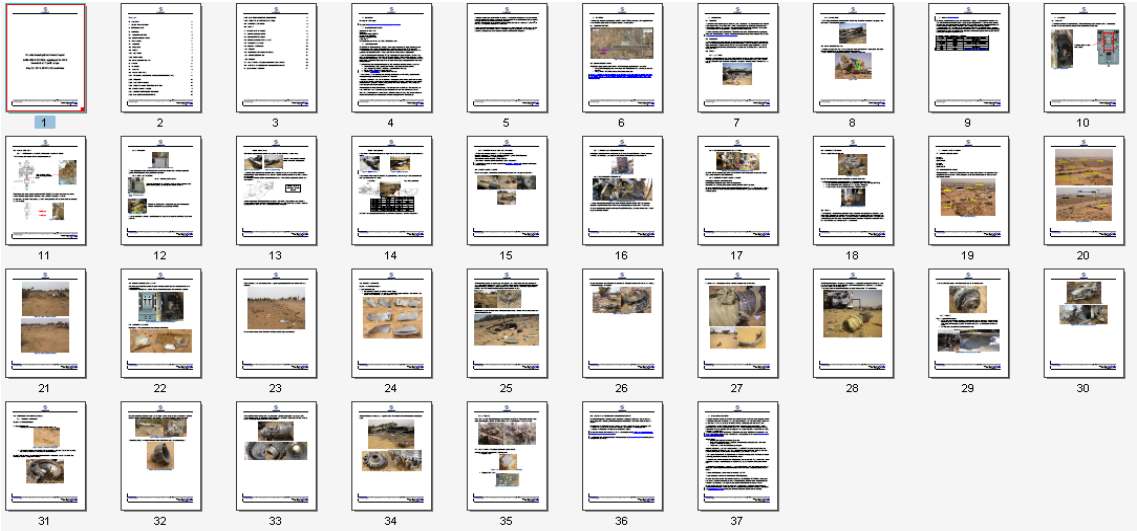




AIRBUS

At incident / accident site

- When on site
  - Airbus investigators act in full cooperation with Investigation Boards
    - Introduce themselves and explain their field of expertise
    - Discuss the action plan
    - Act when agreed
    - Detail findings in real time
    - Document facts into an on-site report



- Review the report with the Investigation Team in front of evidences

Content

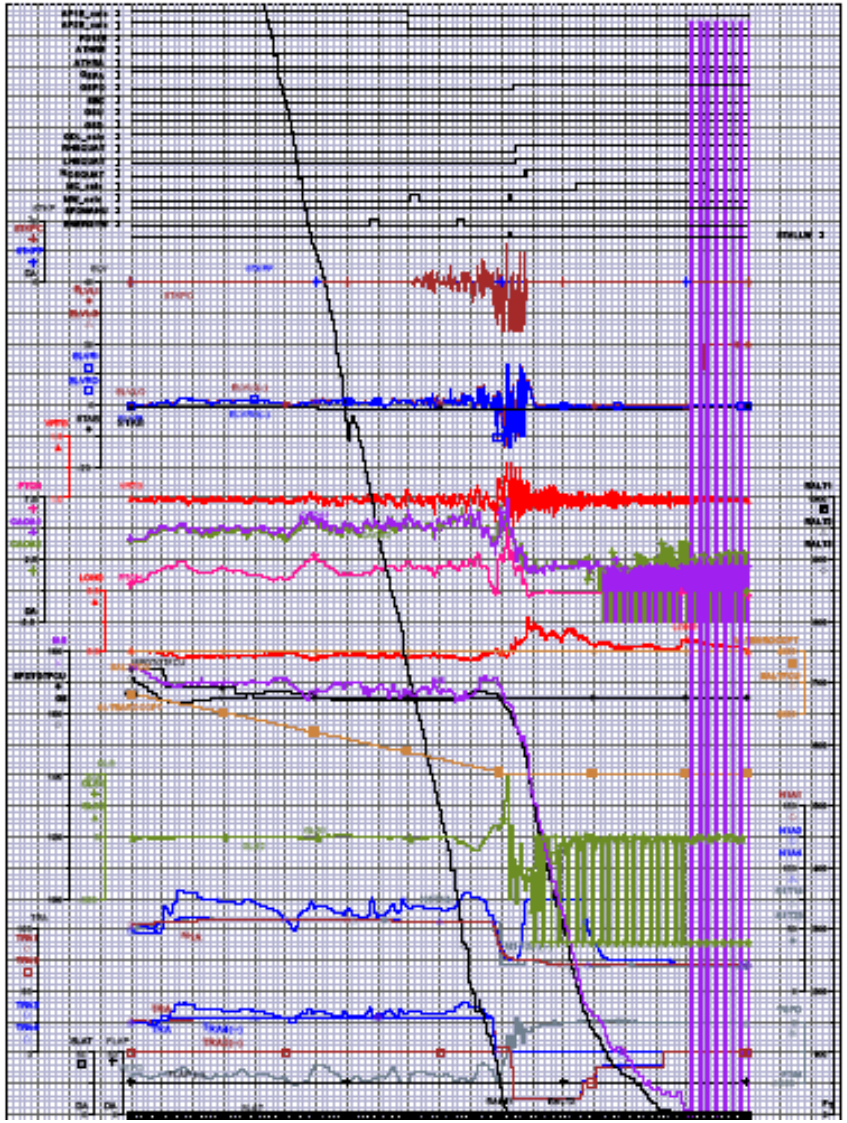
- Familiarization with the Airbus world
- Immediate response to accident
- **Over the duration of an investigation**
- Investigation reports
- Event reporting
- Views on regional cooperation
- Conclusion

Permanent support adapted to the context

- In the frame of accident investigation, manufacturers can provide a wealth of expertise
  - Documentation
  - Engineering tools
  - Full Flight Simulators
  - Flight Test aircraft
  - Human Performance
  - Manufacturing facilities
  - Laboratories
  - Technical & Operations Experts
  - Flight Test Pilots & Engineers
  - Support from suppliers

Flight Data Recorders

- Airbus supports
  - DFDR & CVR readout
  - Sharing of DFDR raw data analysis
  - Operational and engineering expertise
  - Accurate sequence of events
  - Consistency with audio-warnings
  - Synchronization of DFDR with CVR



Computers BITE's, NVM's, ACARS transmissions

- Significant source of information on modern aircraft
- Complements Flight Data Recordings
- Key in recent investigations
  - Runway excursions
  - NLG90° events
  - Depressurization events
  - AF447
  - …

AIRBUS

Iron bird

- Allows investigating complex scenarios that cannot be simulated with FFS
- Allows accurately reproducing some failure modes down to the components

AIRBUS

Full Flight Simulator (FFS)

- Replay the event
- Review procedures
- Investigate human / machine interface
- Consider alternate scenarios

Flight tests

- Further research and development can be supported by flight tests

Examples of investigation domains

- Systems
  - Response to inputs
  - Reconfigurations
  - Cockpit alerts
- Handling qualities
  - Response to inputs
  - Response to environment
- Performance
  - In flight
  - At take-off and landing
- Structure
  - Loads & aeroelastics
  - Structural integrity

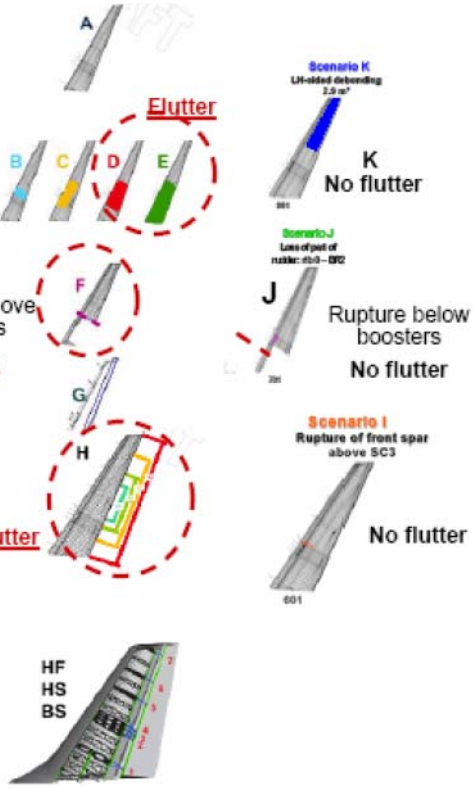
- Airbus has tools and expertise to review the aircraft behavior and the interface with flight crew as recorded versus the model
  - Calibrated with flight test results and certified
- Airbus can also provide support in the human performance analysis

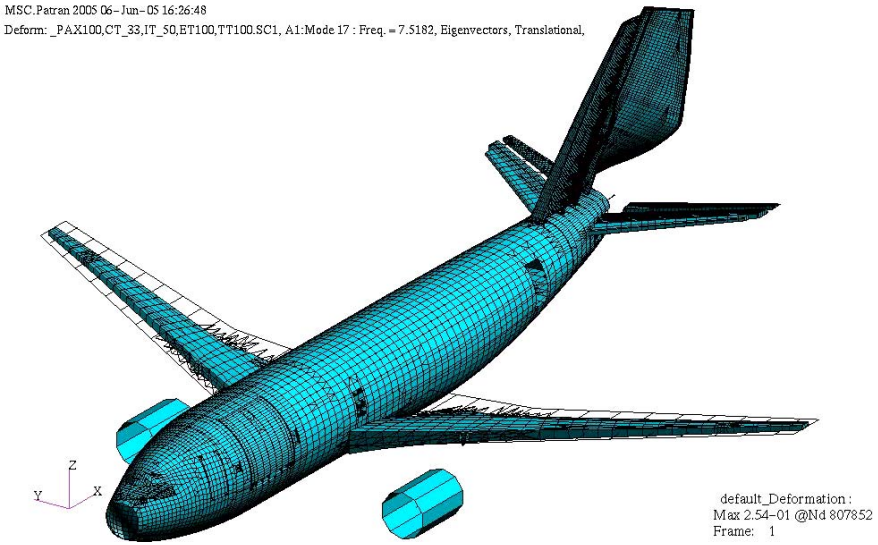
AIRBUS

Examples of engineering investigations (cont'd)

Structure

- **Scenario A:** Normal case, no failure:
  - Proper damping margins for the fin bending / rudder rotation coupling.
- **Scenarios B,C,D,E:** Debonding & K
  - No flutter appears for all cases having a remaining skin stiffness of 20% at the debonded areas
  - LHS failures show nearly identical flutter behaviour as RHS
  - Increasing the size of debonding decreases the damping
  - Double sided failures are more critical than single sided ones
  - For the double-sided scenario D and for scenario E violent flutter appears when reducing the remaining skin stiffness of debonded areas stiffness to 0%.
- **Scenario F:** Loss of lower part of rudder, separation of rudder above boosters
  - Flutter of several couplings below 270 kCAS.
- **Scenario G:** Failure of all TE screws :
  - Low impact on flutter
- **Scenario H:** Failure of trailing edge connection
  Starting from a certain extension of the damage flutter occurs with increasing violence.
- **Scenarios HF:** Various failure of hinges
  Failure of hinge 7 alone or in combination with hinge 1 shows flutter, but outside certification envelope.
- **Scenario HS:** Reduction of hinge stiffness, all 7 hinges
  No critical influence on flutter in the range from 100% - 25% of nominal hinge stiffness
- **Scenario BS:** Reduction of booster stiffness, all 3 boosters
  Significant reduction of boosters stiffness necessary to produce flutter;
  - no flutter for a reduction of 50%
  - flutter at V_F=268k_{CAS} for 75% reduction of boosters stiffness



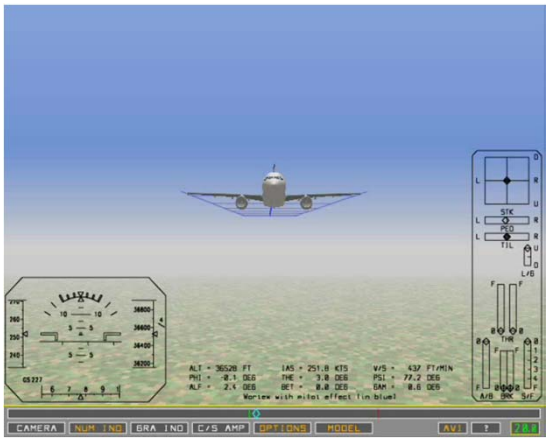


AIRBUS

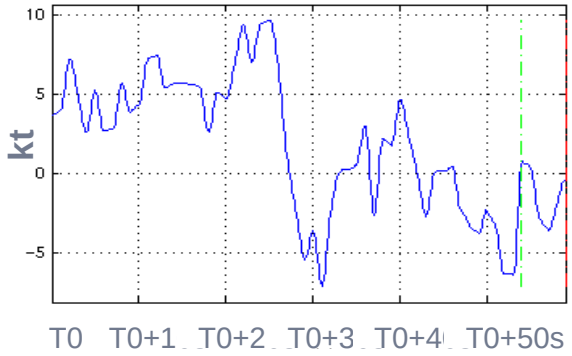
Examples of engineering investigations (cont'd)

Handling qualities

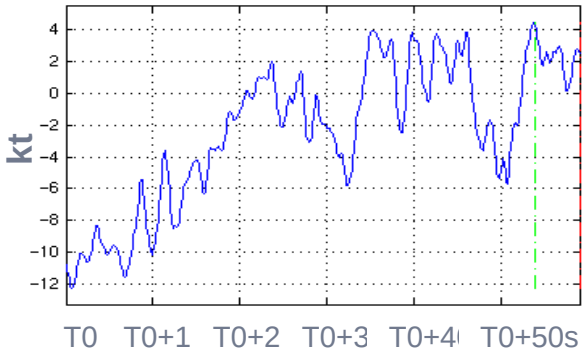
- Response to environment (wind)
- Response to flight crew inputs



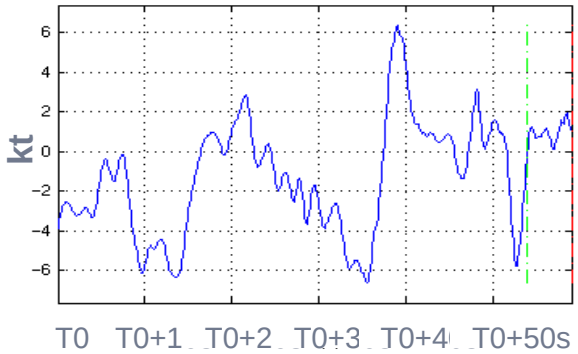
Longitudinal Wind component (X)

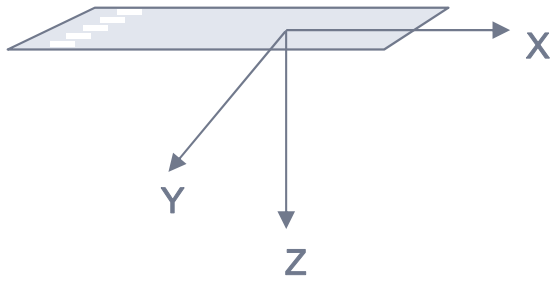


Lateral Wind component (Y)



Vertical Wind component (Z)





Content

- Familiarization with the Airbus world
- Immediate response to accident
- Over the duration of an investigation
- **Investigation reports**
- Event reporting
- Views on regional cooperation
- Conclusion

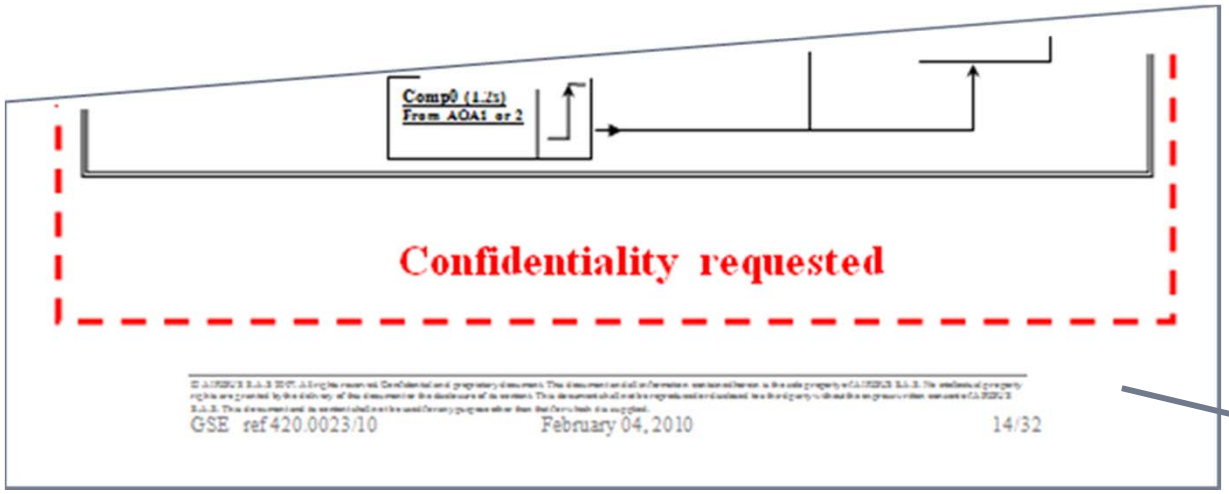
Investigation reports

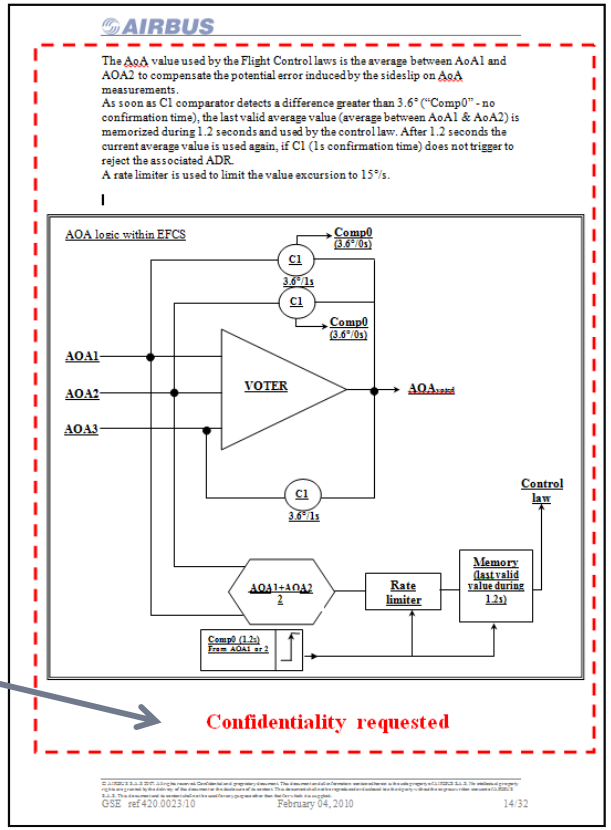
- Airbus provide investigation documents to cover these activities
  - Reports, submissions, presentations…
- Upon agreement, Airbus inputs may appear in Final Investigation Report
  - Some information provided in full confidentiality to the Boards involved
  - Restrictions associated with proprietary data (see next slide)
- Airbus also supports Boards Accident / Incident Investigation
  - Promoting pragmatic and practical recommendations
  - Commenting the draft according to ICAO annex 13
  - Responding to safety recommendations

AIRBUS

The Airbus report(s) – Disclosure of proprietary data

- Proprietary data may be disclosed to investigation parties
  - ➢Some data may not be shared with all parties
    - ✓E.g. limited to IIC and the French BEA
  - ➢When proprietary data is shared, it is identified and confidentiality is explicitly requested





Content

- Familiarization with the Airbus world
- Immediate response to accident
- Over the duration of an investigation
- Investigation reports
- **Event reporting**
- Views on regional cooperation
- Conclusion

AIRBUS

Further to specific event …

WHY the event occurred?

- Design?
- Operational?
- Maintenance?
- Other?

Are there consequences on the involved aircraft?

- Structural / System impact?
- Documentation impact?
- Other?

Analysis required:

- Handling Qualities
- Load assessment
- Perf. assessment
- Etc.

Note: Specific data required

(Flight Data, Crew report, etc.)

Recommendations:

- Operational
- Maintenance
- Design upgrade
- Etc.

Expertise:

- Equipment
- A/C parts

Documentation:

- Operational
- Maintenance
- Etc.

Design improvement

Other

Reporting of events

- ICAO annex 6 (§8.5): reporting from Operator to State of Registry
- Airlines can be requested to report to their own local Authorities
- Reporting from operators to aircraft manufacturers
  - In Europe operators are required to report in-service events to Airbus by EU regulations

What obligations already exist for Airbus?

- EASA (Part 21A.3) requires:
  - That Airbus maintains a « system for collection, investigation and analysis of data »

  - That Airbus reports to EASA any occurrence « which has resulted in or may result in an unsafe condition »

Reporting of events

Events feedback is important for an individual aircraft but also essential for the worldwide fleet

- We must determine why the event occurred and its potential impact
- In-service events are basic inputs for design, procedures and documentation changes or improvements

In-service event reporting directly supports safety, hence, it is our common interest

AIRBUS

Content

- Familiarization with the Airbus world
- Immediate response to accident
- Over the duration of an investigation
- Investigation reports
- Event reporting
- **Views on regional cooperation**
- Conclusion

Regional cooperation – Airbus views

- Airbus has nominated a Regional Safety Director for Latin America & Caribbean
  - Also designated Advance Rep and focal point for safety matters in the region

- Airbus considers that harmonization of the Annex 13 protocols in the Latin America & Caribbean region is in the interest of aviation safety
  - Application of this protocol considering Airbus representation in the event of an accident/incident

- Airbus is ready to discuss specific support to Regional initiatives

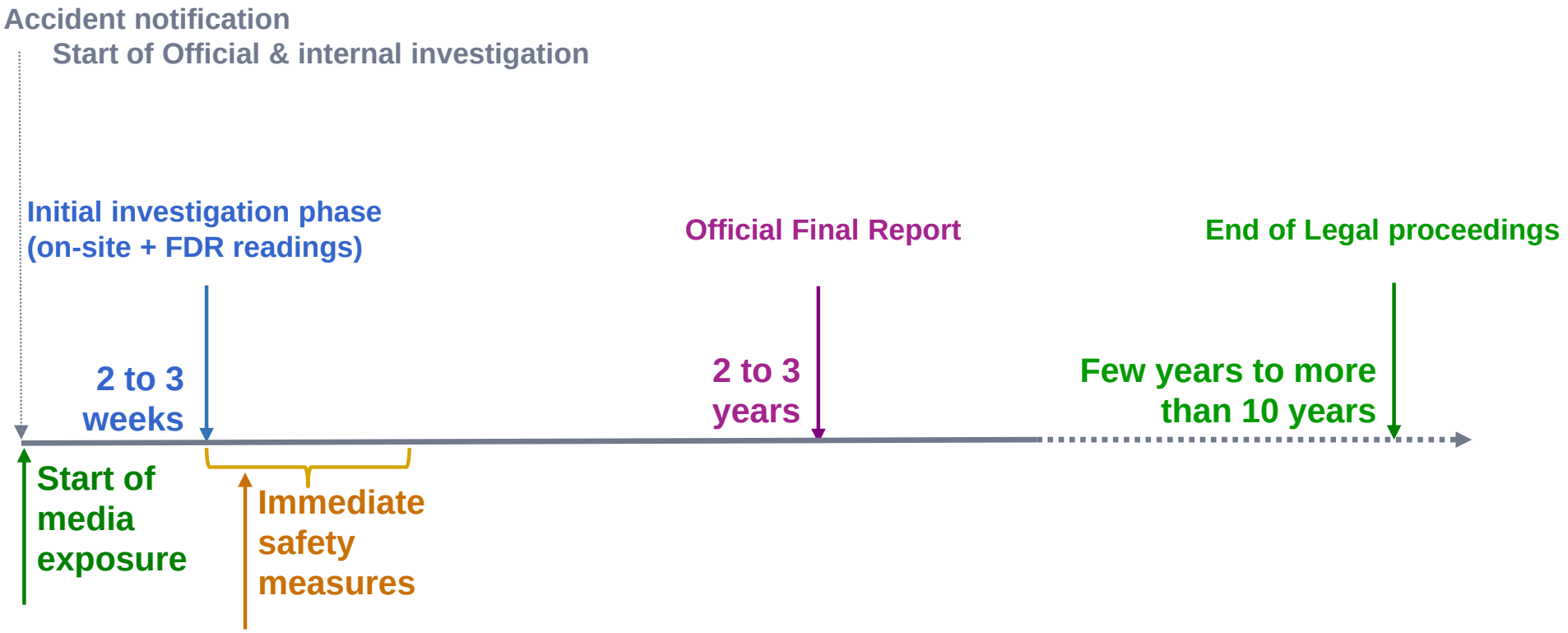
AIRBUS

Content

- Familiarization with the Airbus world
- Immediate response to accident
- Over the duration of an investigation
- Investigation reports
- Event reporting
- Views on regional cooperation
- **Conclusion**

Conclusion - Response to an accident

- Global time scale



Conclusion

- Airbus acts as technical advisor to the state of aircraft manufacture
- Airbus commits in supporting you in your duty to investigate accident and incidents
  - ✓In **anticipation**: familiarization to the Airbus world
  - ✓In **response to crisis:** immediate support
  - ✓**Continuous** technical and operational support over the duration of an investigation
- Airbus completes all activities in full transparency with the IIC
- The sooner you involve us, the sooner we can assist you

AIRBUS

Conclusion

- This cooperation with Investigation Boards promotes a comprehensive investigation which is a necessary condition to answer investigation questions

⇒Early understanding of what happened

- Minimize speculation by giving the main facts
- Work in a more serene environment

⇒It allows achieving our mutual goal: enhance flight safety

- Learn all the lessons from investigated events
- Define effective preventive measures to prevent reoccurrence