ISSUE REVIEW MEETING

2019 ~ IRM 27
Summary Bulletin

A Message from IATA

Nancy Rockbrune, Head, Safety Management, IATA

I am always amazed to see the level of engagement from participants at the Safety Issue Review Meeting (IRM). Whether as a presenter or contributor to subsequent discussions, it is so wonderful to see so many individuals from various stakeholders, openly discuss safety risks, challenges and lessons learned. There is no competition, just a genuine desire to keep driving the safety performance of aviation higher. I would like to thank everyone for the investment made to attend and participate at these meetings and being true advocates for aviation safety.

I would also like to take this opportunity to recognize the help and support of two people who took that advocacy to an even higher level, playing an integral role in IATA Safety over the past two years.

Rick Howell, General Manager Group Safety and Operational Risk Management at Cathay Pacific Airways and Cathay Dragon, just completed his term as Chair of IATA Safety Group. This governance body directly impacts the work IATA does for Industry and under Rick's direction there was focus on an integrated, data-driven approach to managing safety risks to continuously improve safety performance.

Shannon Masters, Manager, Air Safety Investigations at Delta Air Lines, just completed her term as Chair of IATA's Hazard Identification Technical Group (HITG) where she influenced, not only the ongoing development of a Hazard Registry and supporting process, but also the continuous improvement of the IRM and consequent Bulletin. The awareness of IRM and the outreach of the Bulletin has grown tremendously under Shannon's tenure.

On behalf of IATA and all of our members I would like to thank Rick and Shannon for their time and effort over the past two years, and welcome **Mark Burtonwood**, SVP, Group Safety, Emirates as incoming Chair of Safety Group and **Frank Hitzbleck**, Manager Aviation Safety Department and Head of Flight Safety at Cargolux Airlines, as incoming Chair of HITG. Wishing you both much success in these roles.

I look forward to seeing familiar faces at the next IRM meeting in Dallas, and I certainly hope to see new ones too. As always, your active participation enriches the discussions and elevates the value of the meeting.

A Message from the IATA Safety Group Chair

Mark Burtonwood, Senior Vice President Group Safety, Emirates Airlines

As the current IATA SG Chair, it is a genuine privilege to introduce this edition of the IATA IRM Bulletin.

For those of you who attended the IRM in Luxembourg, I'm sure you will agree that it was an exceptional meeting, both in terms of attendance and range/depth of the presentations.

The following pages provide an overview of the presentations and more importantly, the 'lessons learned' and recommendations from the events discussed.

I feel that these learnings are a vital part of the Bulletin. Such articles allow each of us to look introspectively at our own organsiations and potentially implement positive changes without having to experience a similar event.

This leads nicely into one area the Safety Group is currently focusing on, which is Continuous Improvement. One way to improve is to learn from others, and its fair to say that multi-organisational collaboration is one of the keys to leveraging continuous improvement. I would respectfully encourage you to feel comfortable in sharing your events or issues, and resolutions with your fellow safety professionals. We have built up great trust as a small community with integrity, and for good reason. The discretion and respect we show to our industry colleagues is the bedrock of allowing the levels of openness shown, so the wider IATA community can benefit from the learnings. This approach is a precursor to the digital data sharing that, although currently active, is expected to grow significantly albeit in a controlled and appropriate manner.

To close, it would be remiss of me not to make a note of appreciation to the entire team at Cargolux for hosting such a superb event, many thanks indeed!

I look forward to meeting many of you at the next IRM in Dallas, hosted by American Airlines. For those who cannot attend, rest assured we will continue to work diligently to provide a timely, relevant and focused IRM Bulletin to ensure the wider IATA membership can also receive the benefits.

A Message from the IATA Hazard Identification Technical Group (HITG) Chair

Shannon Masters, Manager, Air Safety Investigations, Delta Air Lines

At the close of my two years as chair of the Hazard Identification Technical Group and Issues Review Meeting (IRM), I want to thank you all for being advocates for a safer aviation industry. Over the last two years, we have moved beyond the days of the "Incident" Review Meeting and are truly looking at holistic "Issues" within the industry. By applying Safety Management System (SMS) philosophies to the meeting we have had the opportunity to discuss hazards before they became incidents, share safety program best practices, discuss IOSA standards, and review emerging safety studies.

I hope that each of you have taken something from the IRM and/or the IRM Bulletin and incorporated it into your SMS program for safety improvement. I appreciate those of you that have shared at the IRM, and I encourage everyone to find an opportunity to contribute in future meetings.

Fair Skies and Tailwinds, friends and colleagues! See you in March 2020!

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INTRODUCTION

This year's 27th biannual IATA Issue Review Meeting (IRM), the IATA Safety Group (SG) and the IATA Hazard Identification Task Group (HITG) meetings, hosted by Cargolux, were held in Luxembourg, from September 10th to 11th, 2019.

The presentations were shared and conducted under the Chatham House rule* for the purpose of identifying and sharing of industry specific hazards.

The IRM continues to evolve in an open, constructive and valuable way. This can only take place with the active participation of industry stakeholders like you.

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* *In meetings under the Chatham House Rule, "participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed"* [*https://www.chathamhouse.org/chatham-house-rule*](https://www.chathamhouse.org/chatham-house-rule)

Summaries of IRM 27 Presentations

Please note that not all presentations are summarised

1 UPDATE FROM THE ACCIDENT CLASSIFICATION TECHNICAL GROUP (ACTG)

The ACTG is a sub-group to the Safety Group (SG) and is comprised of safety experts from airlines and manufacturers, which ensures that a variety of accident and incident aspects are covered. The group analyses accidents, identifies contributing factors, determines trends and areas of concern relating to operational safety and develops prevention strategies. The group uses the IATA Accident Database, which covers all commercial aviation accidents worldwide since 2005 that meet IATA accident criteria. The list of new accidents is validated and classified every six months using a Threat and Error Management (TEM) model.

Data is used to create the annual **IATA Safety Report**, which is the flagship safety document provided by IATA since 1964 and provides the industry with critical information derived from the analysis of aviation accidents to understand safety risks in the industry and propose mitigation strategies. The report contains essential insight into global and regional accident rates and contributing factors, key trends and statistics on accidents by category and region, prevention strategies as applicable to major accidents contributing factors, and It is made available to the industry for free distribution.

The IATA Safety Report 2018 can be downloaded through the following link:

https://www.iata.org/publications/Pages/safety-report.aspx

2019 Mid-Year Accident Update

The following provides an overview of commercial aviation's safety performance for the first half of 2019. As such, any comparisons can only be considered preliminary at this time.

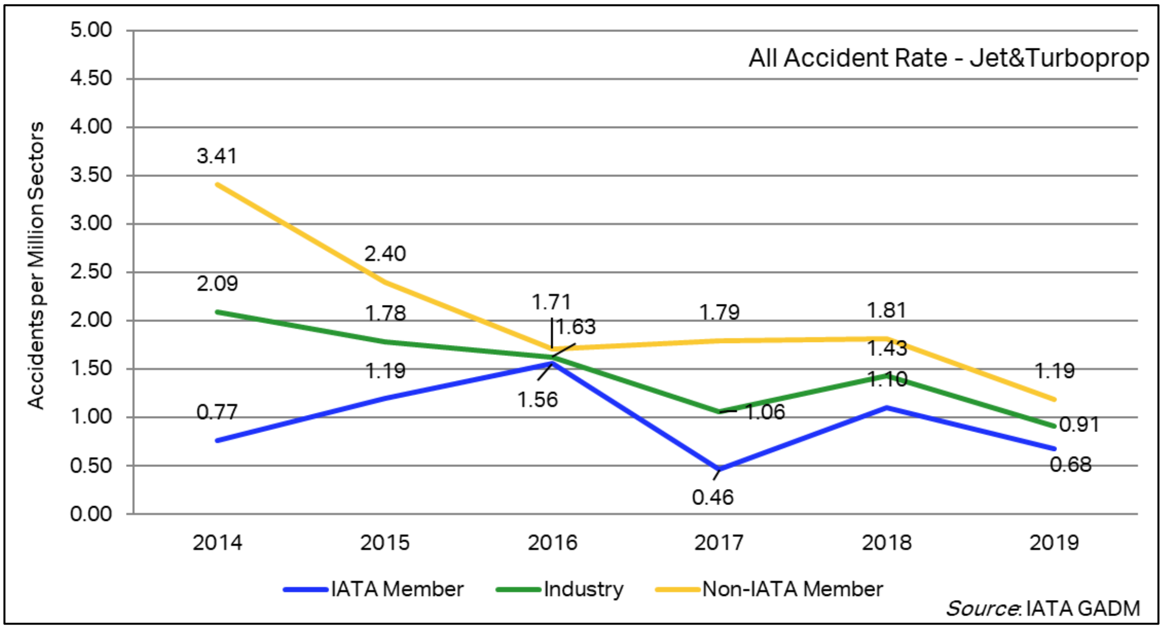
This update was classified by the ACTG on June 10th - 12th, 2019. However, due to the latency time between an accident occurrence and its reporting, this update may not contain all accidents that occurred in the first half of 2019.

- During the first half of 2019, there were a total of 20 accidents worldwide, of which three incurred fatalities. The three fatal accidents (all jets) incurred 201 on-board fatalities
- IATA member airlines suffered a total of eight accidents, three of which resulted in the 201 fatalities
- In the category 'all accidents per million sectors' IATA member airlines continue to trend lower than all industry at 0.68 versus 0.91 in 2019, a pattern that is also reflected in the five-year average
- It is worth noting that the accident rate is extremely low, so any accident will create a spike

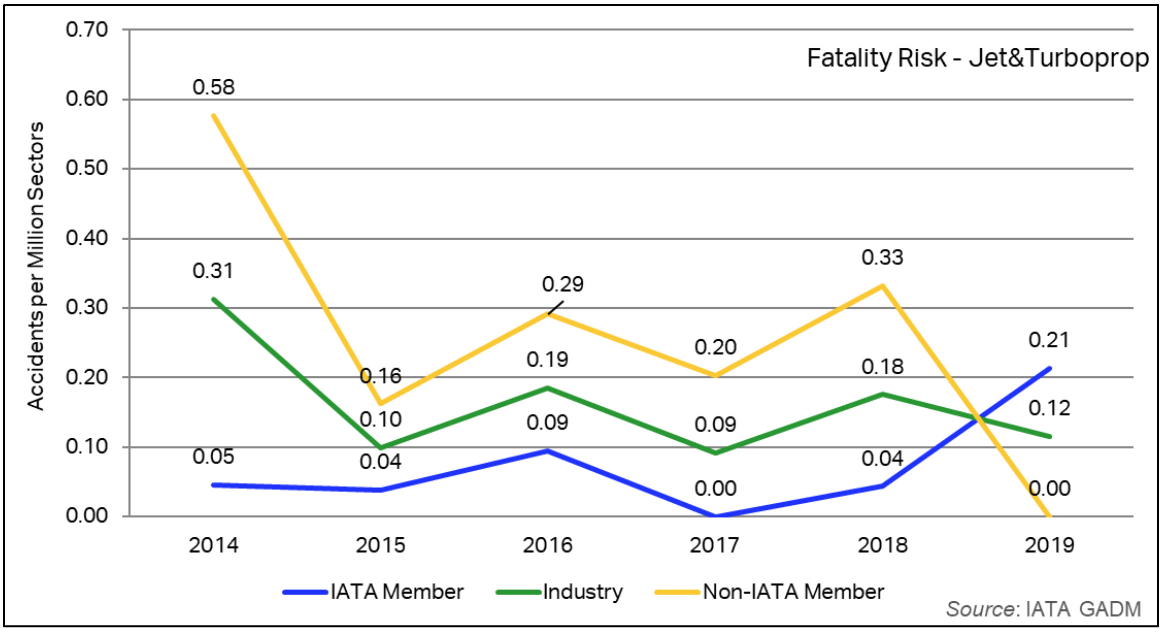
2019 All Accidents Overview

Total Accidents	20
Total Fatal Accidents	3
Total Fatalities on board	201
Total IATA Member Accidents	8
Total Jet Hull Losses	3
Total Turboprop Hull Losses	1

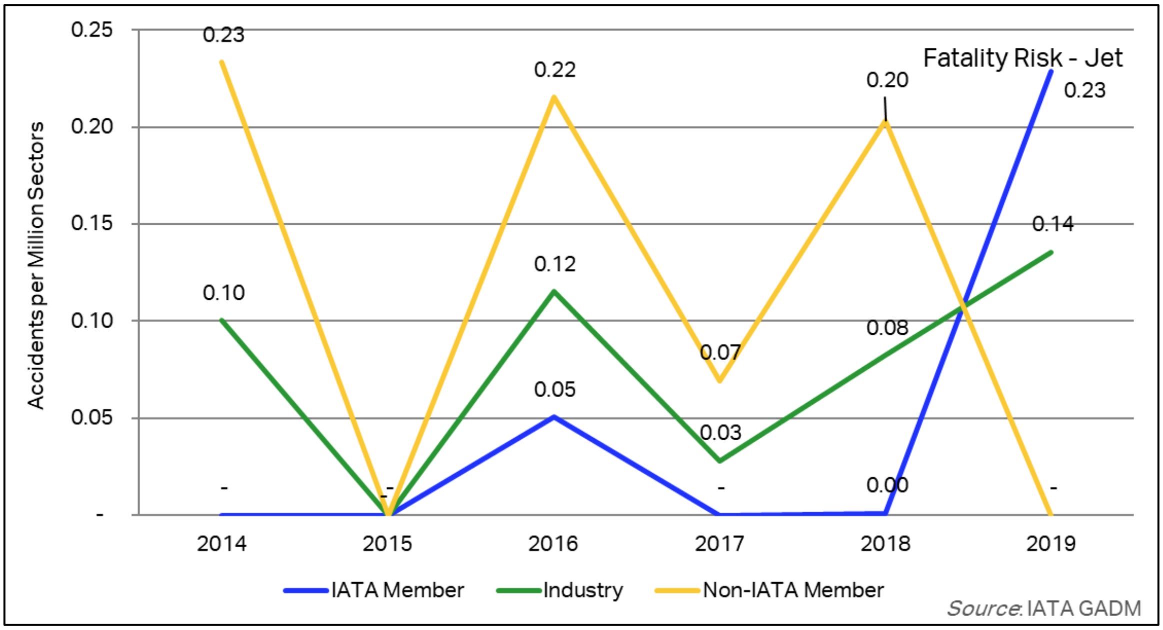
First half of 2019 has seen the overall accident rate decrease over 2018, across all the industry, with 20 accidents. It is important to note that this comparison is preliminary, since it only covers the first 6 months of 2019.



Fatalities

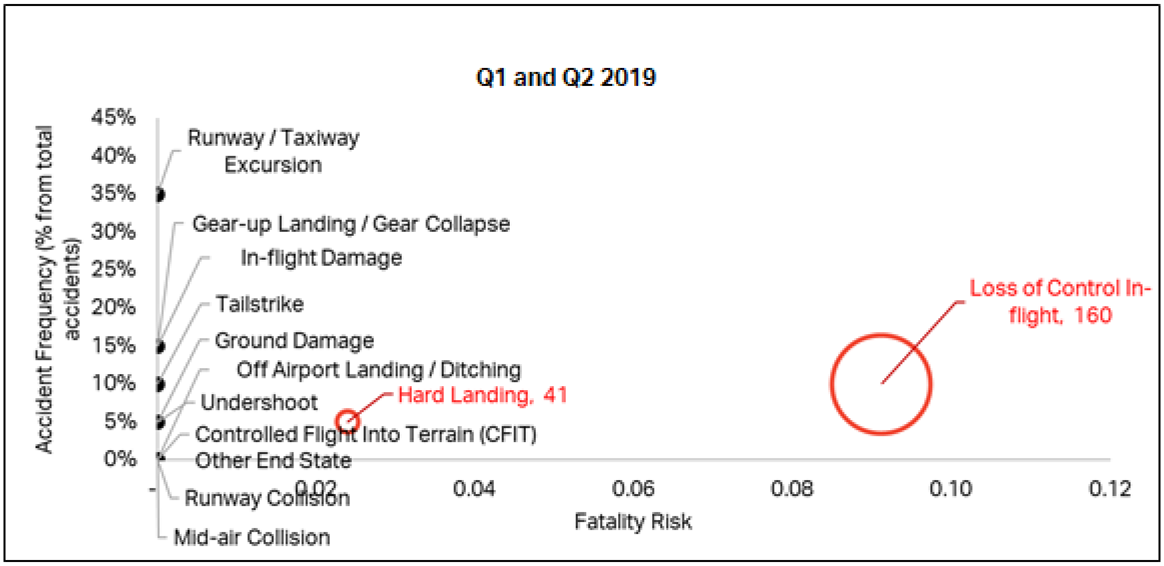


Due to the three fatal accidents that involved IATA member airlines, the first half of 2019 has seen the fatality risk for jet aircraft increase from 2018.



During the first half of 2019, across all the industry, there were no fatal accidents that involved turboprop aircraft.

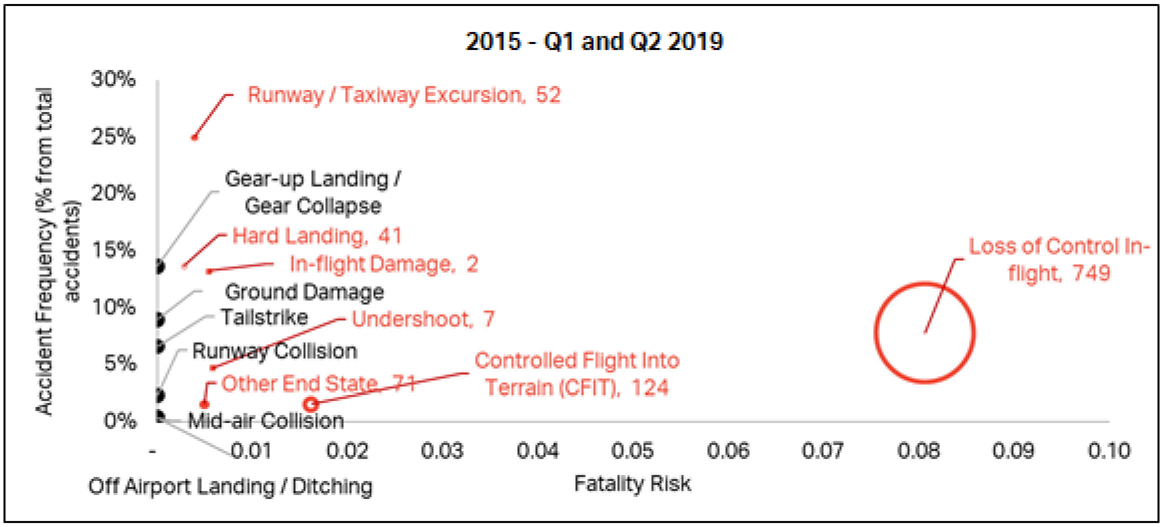
LOC-I and Hard landing are the fatal end states in the first half of 2019



Note:

1. The area of the bubble indicates the number of fatalities associated with the particular accident category, the value is displayed
2. Fatality Risk: number of full-loss equivalents per 1 million flights
3. Accidents not involving fatalities are displayed on this graph as black circles

LOC-I, CFIT and RWY Excursion Caused the Most Fatalities from 2015 to 2019



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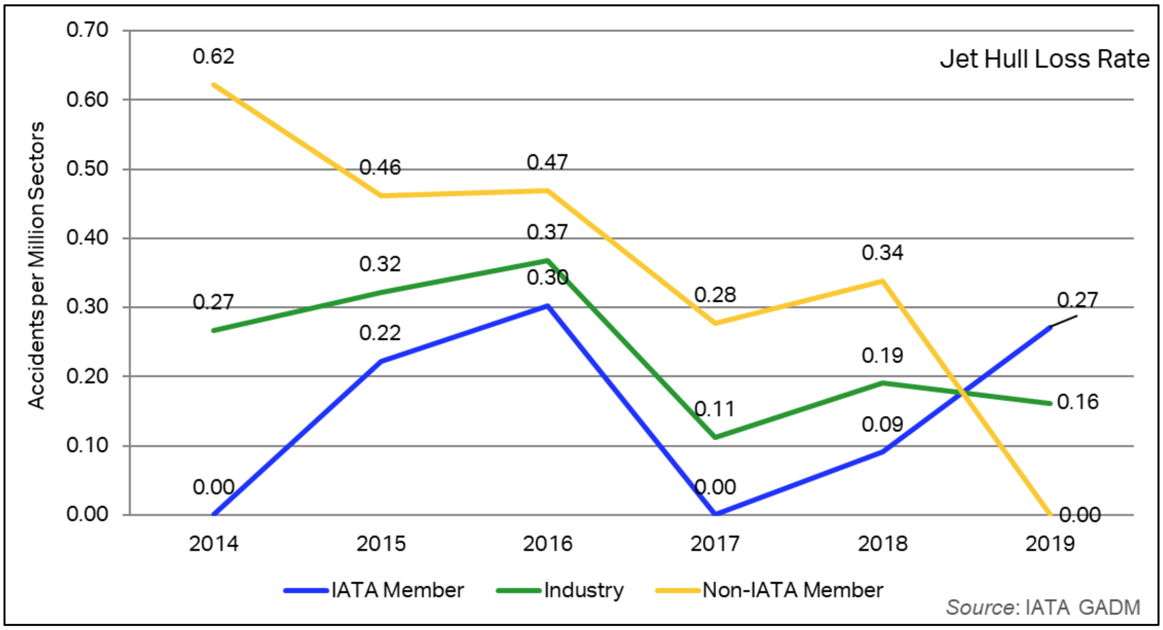
2. Fatality Risk: number of full-loss equivalents per 1 million flights
3. Accidents not involving fatalities are displayed on this graph as black circles

Jet Hull Losses

Global Jet Hull Loss increased in the first half of 2019 for IATA members due to the three fatal accidents in the first half of 2019, which involved IATA member airlines.

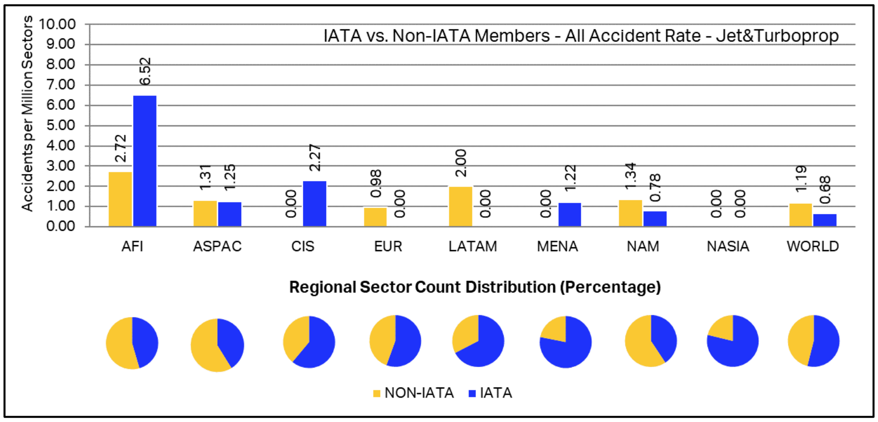


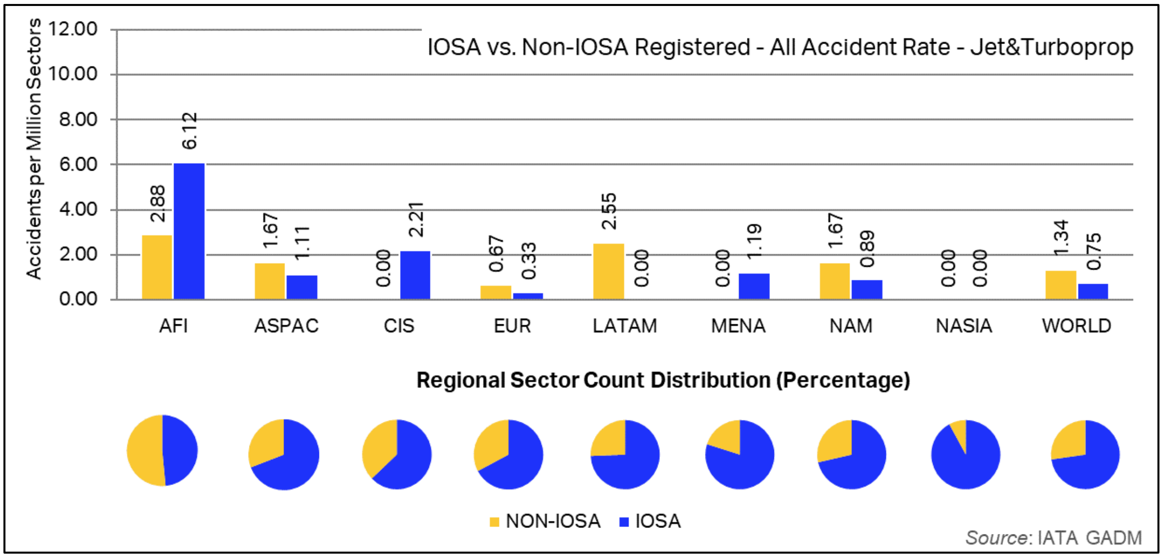
In the first half of 2019, there was one turboprop hull loss accident, which resulted in a runway excursion.

IATA/IOSA Accidents

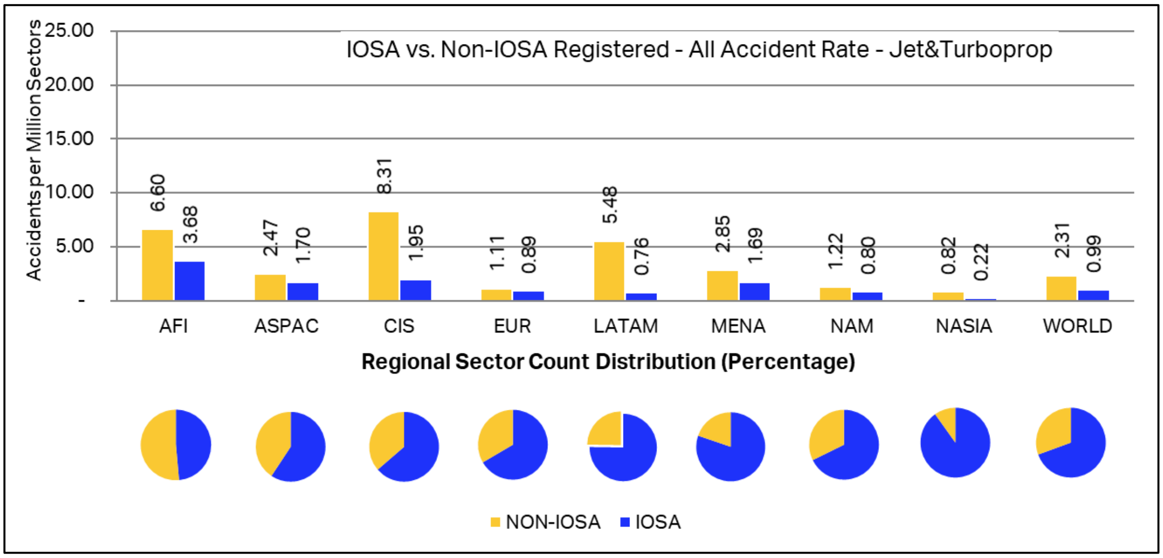
In the first half of 2019 the IOSA carriers Accident Rate was lower than for non-IOSA carriers in four out of eight regions. The accident rate for IOSA carriers in the first half of 2019 was almost two times lower than the rate for non-IOSA carriers.

The IATA Member Accident Rate is lower in 4 out of 8 regions.





IOSA registered airlines keep outperforming non-IOSA airlines in every region, on a five-year trend.



2 ACCIDENT INVESTIGATION SUPPORT PROGRAM – CHALLENGES OF ANNEX 13

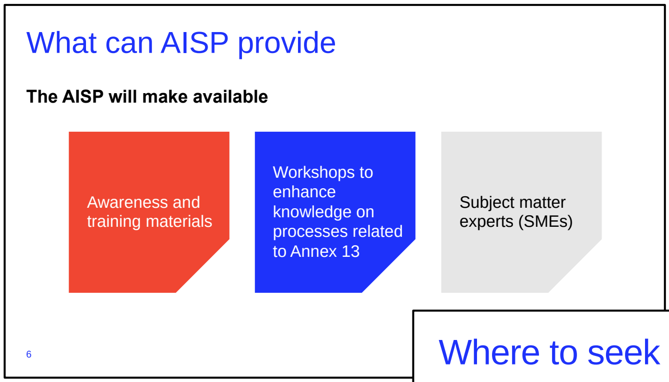
The IATA Accident Classification Technical Group (ACTG) has raised concerns over the lack of ICAO Annex 13 investigation reports. A study has revealed that about 300 accident reports were available for the approximately 1,000 accidents that occurred in the last decade. The conclusion is that significant safety information is not becoming available for accident prevention and safety management actions. The ICAO Air Navigation Commission (ANC) has confirmed the concerns and has proposed actions to address the issue.

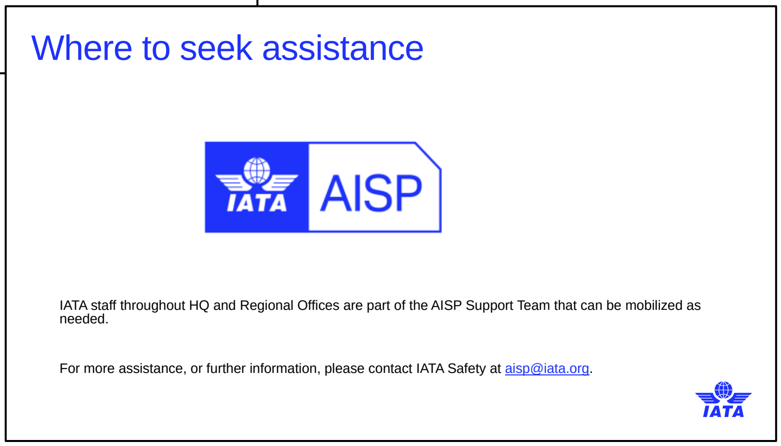
IATA's Initiative

IATA is working closely with ICAO to address the lack of investigation reports and has developed the Accident Investigation Support Program (AISP) to meet ICAO Annex 13 challenges experienced by airlines. The AISP offers guidance and support to airline executives in managing the complex environment resulting from an accident or incident. The AISP is a supplemental tool not intended to replace the individual airline's Emergency Response Plan (ERP). The program provides direct assistance in support of an airline specific needs to complete an ICAO Annex 13 report and appropriate recommendations in a timely manner.

The AISP provides airline management with enhanced knowledge on:

- How Annex 13 works
- What the roles of the State and other Organizations play in an investigation
- How to best manage internal and external challenges
- The best strategies to facilitate an investigation process





Challenges Confronting Airlines

- **INEXPERIENCE –** Many States and airlines have no direct practical experience with the application of ICAO Annex 13 guidelines for accident investigations and therefore have limited preparedness. This is one of the factors prompting the formation of the IATA AISP.

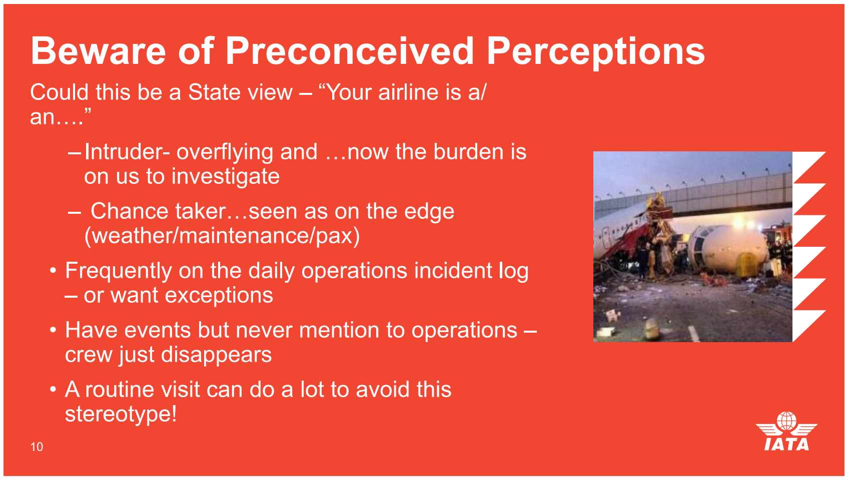
- **DIFFERENT LEGAL SYSTEM –** The legal system in the state of occurrence may view an accident differently from the perspective of the legal principles of the state of the operator and airline management.

  IATA expertise is available to provide strategies that can be employed to support the investigation process and minimize undue risk.

- **STANDARDS AND RECOMMENDED PRACTISES (SARPs) ARE WRITTEN FOR NATION STATES –** Airline personnel serve within the investigation as advisors to their State Accredited Representative (ACCREP), which may create loyalty issues based on the home agency, continuing operational safety issues and peripheral governmental activities.

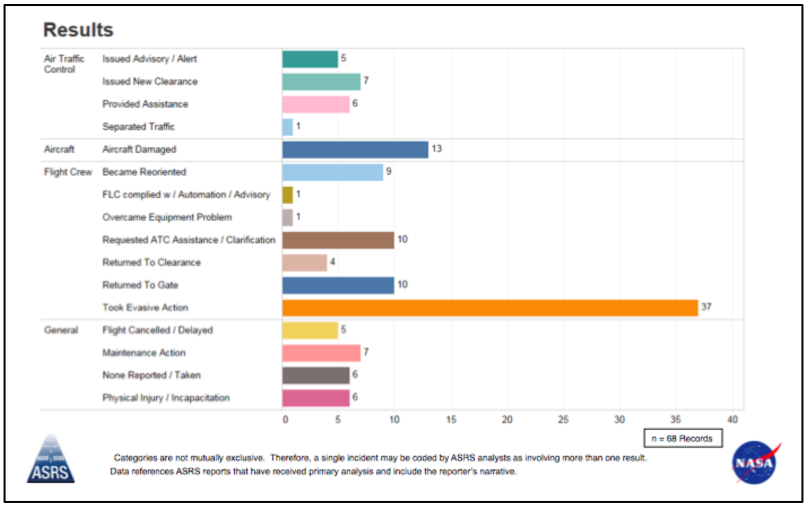
- **ON-GOING OPERATIONS –** There are operational pressures that may limit the ongoing participation of airline stakeholders in the investigation.

- **PRECONCEIVED PERCEPTIONS –** The initial contact with authorities can set the tone to the entire investigation. Maintaining mutual respect amongst all participants will enable a cooperative spirit that will be beneficial to all and the entire investigation.



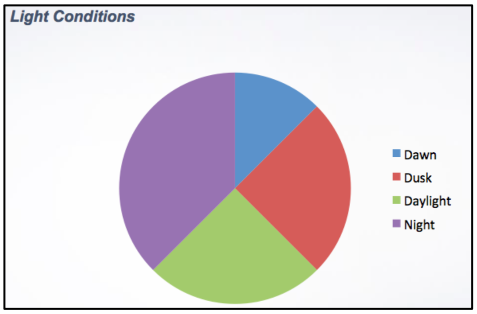
3 WINGTIP GROUND CONTACT WHEN TAXIING

Following an increase in the number of incidents and accidents resulting in aircraft damage where one aircraft hit another aircraft during taxi by the flight crew, the presenting airline launched an investigation to try to find the root causes for this increase. The investigation focused on eight events over a period of 13 months, and it included a review of the post-event flight safety debriefs, as well as the filed safety and aircraft damage reports. The investigators also conducted in-depth phone interviews with captains, involved in each incident



When looking into the NASA Aviation Safety Reporting System (ASRS), concerning Part 121 aircraft weighing over 40,000 lbs, a total of 68 similar incidents were discovered. In addition, the NTSB Accident Data Management System (ADMS) database for accidents and incidents with the same criteria as the ASRS search showed an increase in ground collision events as well.

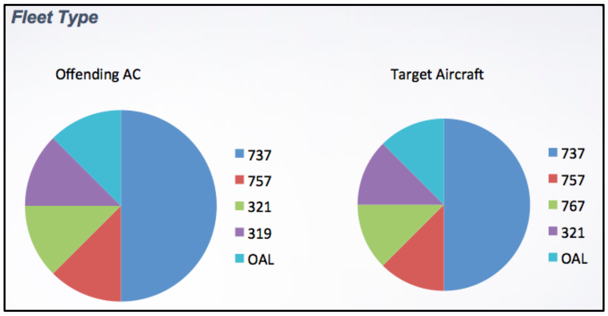
When analysing the ASRS database, it was discovered that 60% of the incidents were caused by Human Factors (HF) related issues and that most events arose from flight crews taking evasive actions when taxiing.



According to the airline's own database, the majority of events occurred between official dusk and dawn and at night, with the B737 accounting for approximately 50% of the aircraft types involved in ground-related incidents, regardless if it was the offending aircraft or the target aircraft. Most events involved a wingtip striking the horizontal stabiliser.

The investigation concluded that the root causes of these events could be attributed to:

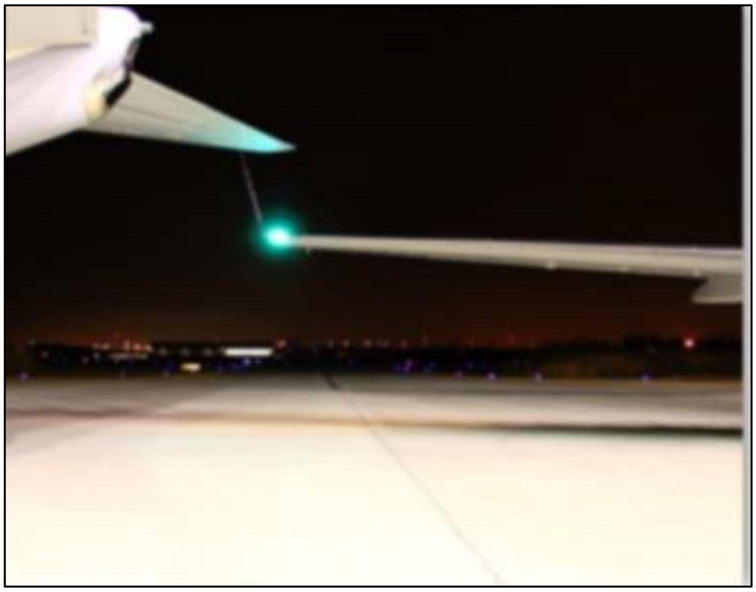
- Aircraft moving off the centreline when taxiing
- Perceptual illusions associated with winglets and horizontal stabilizers
- Aircraft waiting for its assigned parking spot with its tail extended into the active taxiway behind



B737 Winglets

The winglets on a B737 are over eight feet tall and approximately four feet wide at the base, narrowing to approximately two feet at the tip, which adds **almost five feet to the total wingspan.** In addition, the top of the winglets extends outward approximately 2.5 feet relative to the winglet's attachment point. This outwards slant is difficult to detect from the flight deck.

The outer trailing edge of the horizontal stabilizer sweeps back in a v-profile approximately six feet past the tail cone, which means that the trailing edge of the horizontal stabilizer extends six feet past the end of the tail or exhaust port of the APU. Unaware of this configuration and the difficulty of detecting the narrow profile exhibited by the stabilizer, since it exhibits a narrow profile making it appear further away than it actually is, a pilot may inadvertently use the tail cone of the airplane as a reference point to judge the distance between his airplane's wingtip and the other airplane.



Research has consistently demonstrated that depth perception at distances greater than 10 feet is inaccurate and that inaccuracies increase with greater distances, such as the 87 feet distance from the cockpit to the winglet.

Lessons Learned / Comments

Human Factors

Pilots should

- Avoid deviating from the centreline to move around an aircraft that is stopped
- Pay close attention of location of other aircraft and confirm all radio calls
- Don't turn into the gate if you can't taxi all the way into the parking position, even though that means that the taxiway behind is blocked
- Be aware about perceptual illusions associated with winglets, even on a clear day

Questions which should be considered following a ground collision

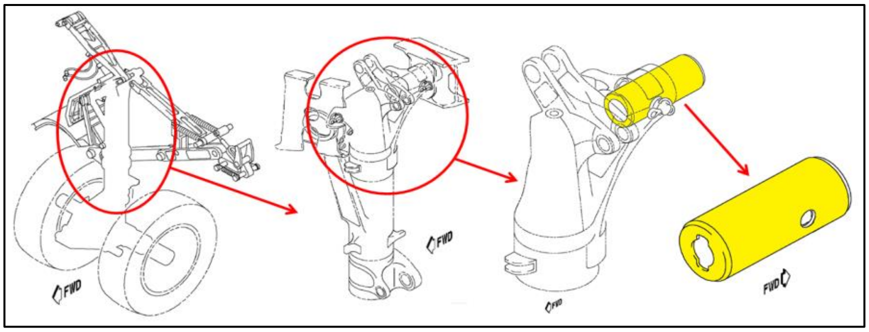
- Is there debris on the taxiway or runway?
- Should you call the RFF?
- Should the engines be shut down?
- Is it OK to taxi? May be APU damage, fuel/hydraulic leaks
- Is a maintenance inspection required before taxi?
- Should you turn on new systems per Maintenance's request?
- Should the crew continue their schedule?
- How does a ground collision mentally affect the pilots?

Conclusion

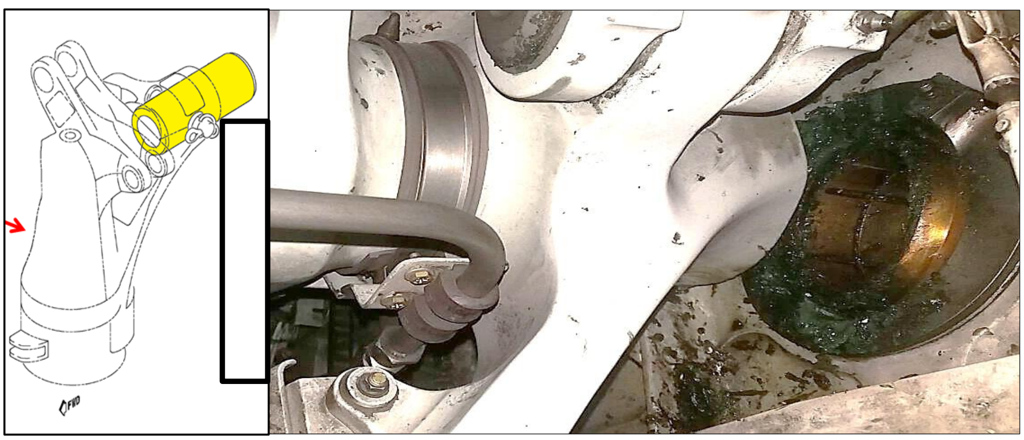
- Situational awareness of the perceptual illusions associated with winglets needs to be improved
- Training needs to be improved
- Efforts with Clean Ramp Policy needs to be continued
- An aircraft damage checklist and procedures following a ground collision need to be considered

4 B737 – LANDING GEAR STRUCTURAL DAMAGE DUE TO TRUNNION PIN FAILURE

A Boeing 737-800 suffered substantial structural damage when the trunnion pin in the landing gear failed during the landing roll.



The touchdown in good weather conditions was firm, but not hard, with a maximum recorded g-load of 1.48g. After landing, when vacating the runway, the flight crew were informed by the cabin crew about an unusual loud noise coming from the landing gear area.

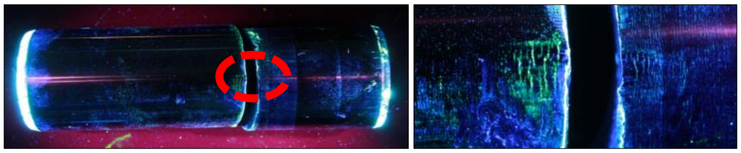


Engineering subsequently discovered that the aft part of the trunnion pin was missing and that the failure of the trunnion pin had caused substantial damage on other aircraft parts.

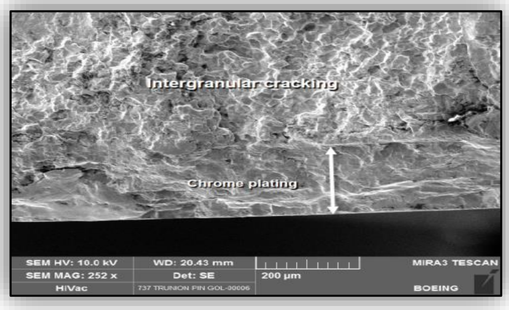
BR&T Examination

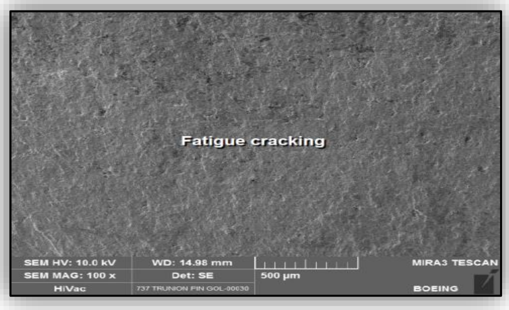
Boeing's Research and Technology (BR&T) technical group performed a non-destructive, metallurgical and fracture analysis examination of the trunnion pin that included the following examinations:

- Barkhausen Magnetic Noise Inspection (RMB)
- Fluorescent Penetrant Inspection (FPI) that revealed indications of cracking in the chrome layer in a corresponding region of the fracture origin point



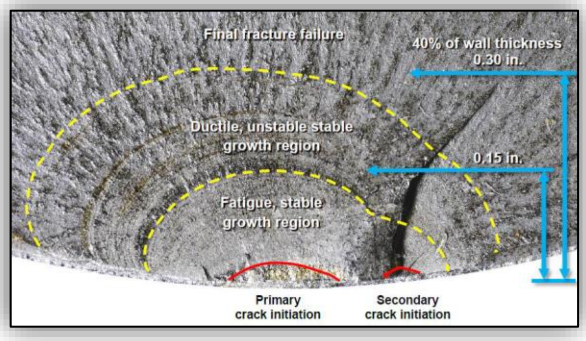
- Magnetic Particle Inspection (MPI) that revealed signs of cracking in the same region pointed by the FPI, adjacent to the fracture origin point
- Scanning Electron Microscope (SEM) inspection, which identified an intergranular cracking caused by material fatigue



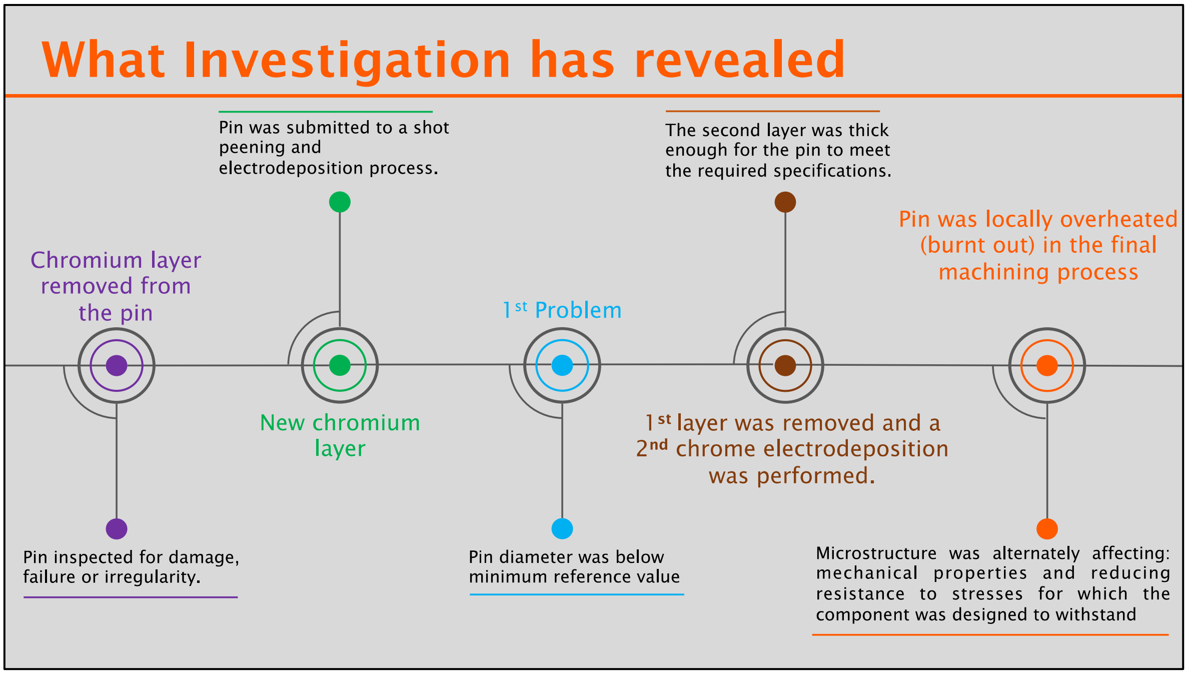


- A Metallographic Exam (ME), which confirmed the existence of a region of the metal microstructure that had been altered by the exposure to high temperatures and thereby negatively affecting its mechanical properties

- The Nital Etch Inspection (NEI), which revealed a dark area on the outer face of the base metal, encompassing the starting point of the rupture



It was concluded that normal operational cycles led to the initiation of a crack in the damaged base metal surface. It also revealed that the trunnion pin installed in the aircraft had been damaged during overhaul when the chromium layer machining process performed by the Maintenance Repair and Operations (MRO) was in disagreement with the procedures established by the manufacturer. Due to fatigue, the crack slowly and steadily propagated up to 20% of the pin wall thickness and unsteadily up to 40% within 3,969 cycles. It was later discovered that another operator with the same aircraft type had suffered similar trunnion pin failures.

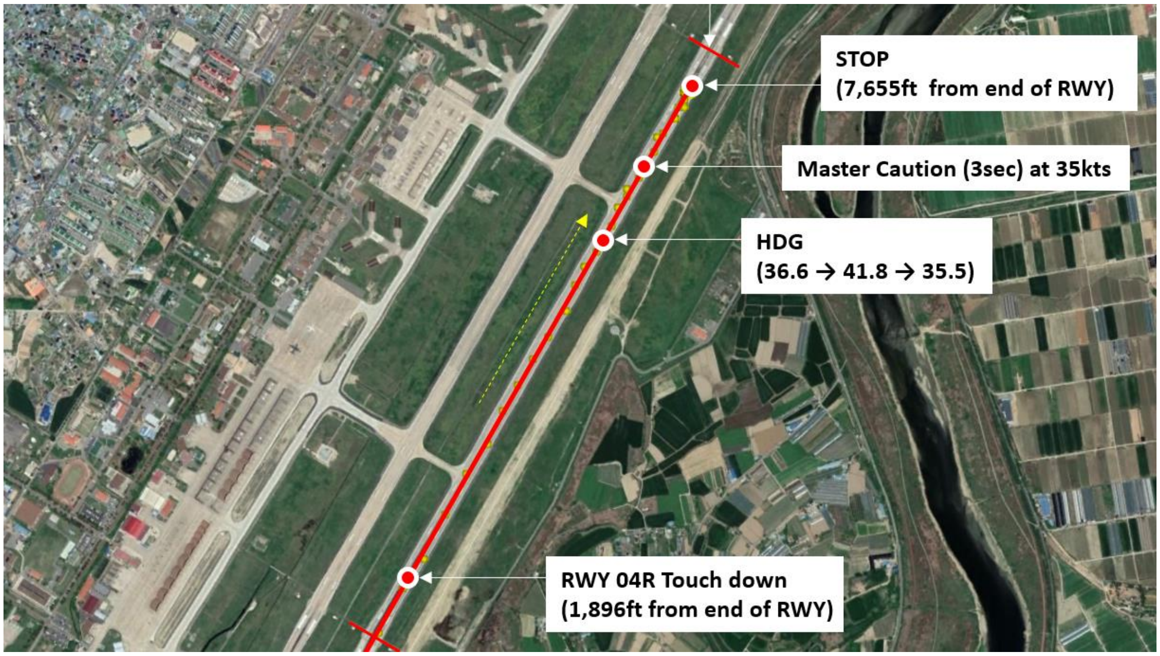


Lessons Learned / Comments

- MROs have different automation levels in the machining process parameters, such as: cutting speed, feed rate and depth of cut. Less automation can increase the chance of human errors
- Visual and MPI inspections after the electrodeposition process may detect chromium cracking but not damages to the base metal
- It may not be possible to monitor a pin failure trend since there are no parameter changes during line operations

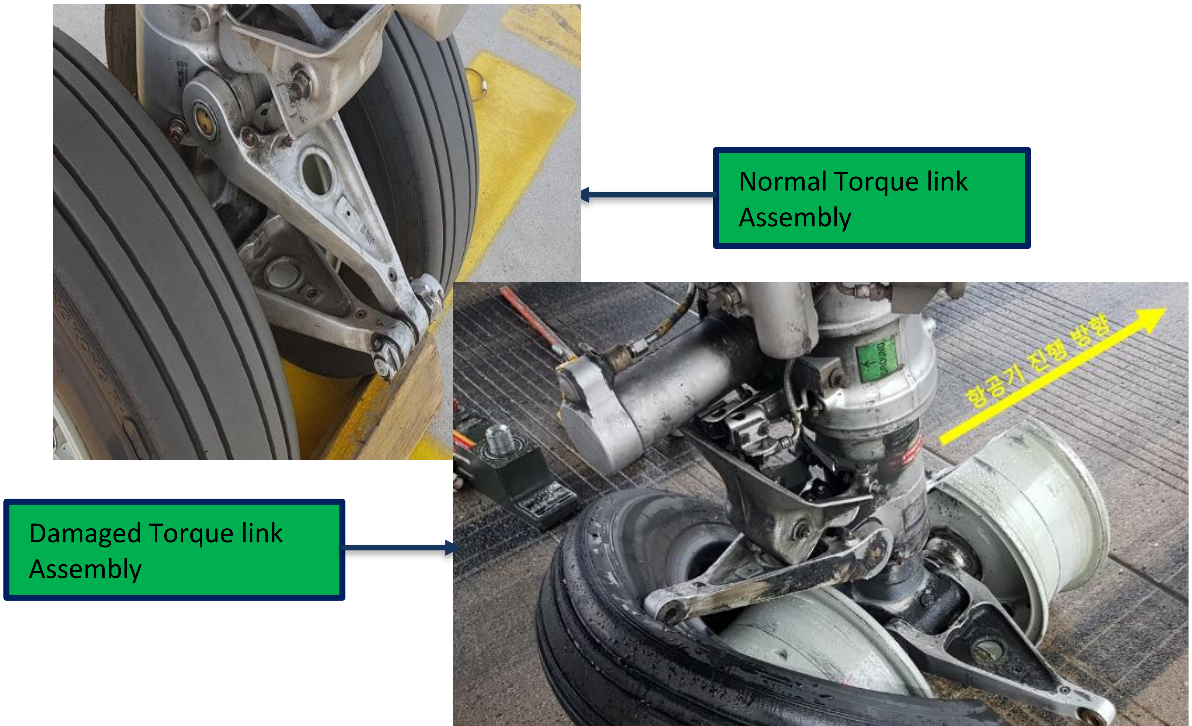
5 A320 – NOSE WHEEL DAMAGE DURING LANDING ROLL

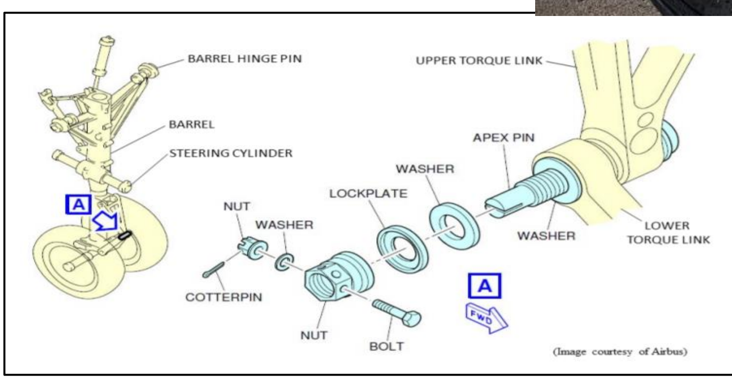
After a normal landing in good weather conditions, an Airbus A320 experienced nose wheel shimmy and severe vibrations during the landing rollout at approximately 80 knots. The Captain stopped the aircraft on the runway due to directional control difficulties and requested towing assistance.



When the ground staff arrived at the aircraft, they found substantial damage to the nose gear and tire, which prevented towing for approximately 24 hours. The passengers were disembarked via external steps.

The subsequent investigation revealed that the event was caused by damage to the Torque link assembly.





Reports had previously been made regarding Apex pin-nut detachments, which led to a Service Bulletin (SB) being issued in 2012 that introduced a new type of Apex pin. To prevent the pin-nut from falling from the Apex pin, more screw threads were introduced on the pin and an additional lock plate placed on top of the nut to make it stronger.

The aircraft involved in the incident had the updated Apex pin installed in June 2017. However, it still detached from the torque link assembly. The Apex pin was not broken but it was discovered that the screw threshold was partly corroded, which had not been detected during inspections. It can be noted that there were no inspection criteria established for the screw threshold. The only requirement was to perform visual checks of the Apex pin at regular intervals.

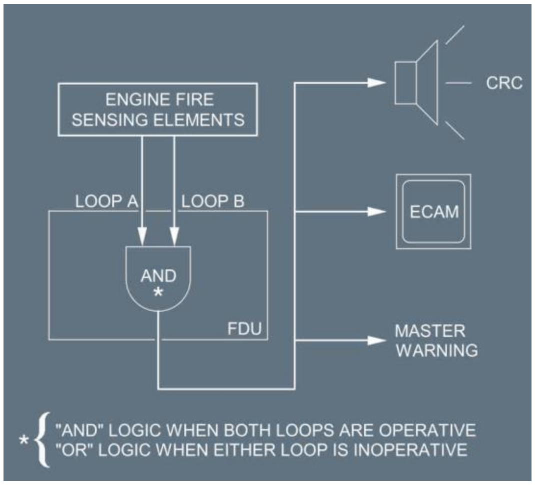
The failure to detect and remove the worn-out pin was the main contributing factor in this event.

Lessons Learned / Comments

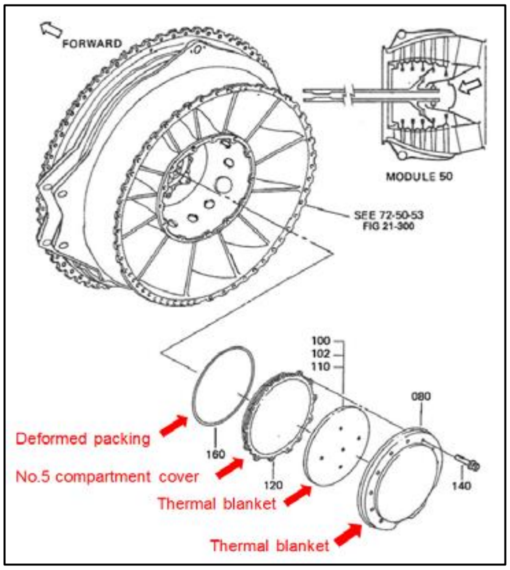
- Important to have all personnel prepared and trained for events of this nature
- The Captain used correct procedures to bring the aircraft to a safe stop
- Aircraft parts were replaced within 24 hours, however, if the Torque link assembly had been checked and the worn-out parts replaced the incident could have been prevented

6 A321 – ENGINE INFLIGHT SHUTDOWN

Approximately 50 minutes after take-off from Hong Kong International Airport (VHHH) an ECAM engine fire warning activated for Engine number one (ENG1). The flightcrew shut down the engine according to Airbus Abnormal and Emergency Procedures and the flight diverted to an Enroute Alternate Airport.



The Airbus A321 overheat detection system consists of two identical detection loops (A and B) mounted in parallel and a Fire Detection Unit (FDU). When a sensing element in the loops is subjected to heat it sends a signal to the FDU, and as soon loops A and B detect temperatures above a pre-set level a fire warning is activated.



The event flight was the first flight after the completion of a 7,500 hour-check. During the check, the No. 5 bearing compartment cover in ENG1 was replaced. During the installation process, the packing of the compartment cover was damaged and deformed. It was noted that this was the first time the engineer who completed the work had performed this procedure.

During flight, hot oil leaked from the deformed packing and dropped on top of the fire loop, which activated the fire warning when the flight was climbing from FL276 to FL300. The flight crew carried out the ECAM actions, which included shutting down ENG 1.

ENG 1(2) FIRE (Cont'd)
(IN FLIGHT)

Ident.: PRO-ABN-ENG-DQ-00018190.0002001 / 21 MAR 17

LAND ASAP

THR LEVER (AFFECTED)....................IDLE
ENG MASTER (AFFECTED)....................OFF
LP and HP valves close.
ENG FIRE P/B (AFFECTED)....................PUSH
When pushed:
- *Aural warning stops*
- *The light remains on, until the fire is extinguished, regardless of the position of the ENG FIRE pb-sw*
- *FADEC is no longer supplied.*

AGENT 1 AFTER 10 S....................DISCH
The 10 s delay allows N1 to decrease, reducing nacelle ventilation, and thereby increasing the effect of the agent.
Automatic countdown on the ECAM.
ATC....................NOTIFY
Notify ATC of the nature of the emergency, and state intentions

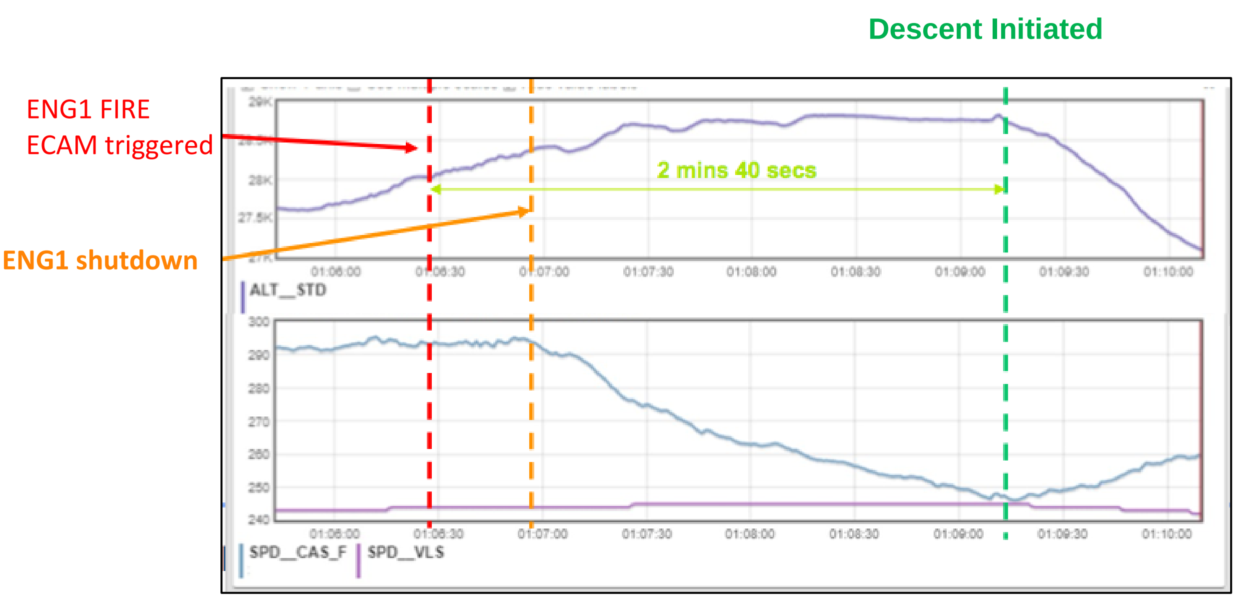
● **IF FIRE AFTER 30 S:**
AGENT 2....................DISCH
Discharge the second agent, if the fire warning remains 30 s after the discharge of the first agent.

ASSOCIATED PROCEDURES

ENG 1(2) SHUTDOWN
Do not attempt to restart the engine.
For the ENG SHUTDOWN procedure, see the ENG section (Refer to PRO-ABN-ENG ENG 1(2) SHUT DOWN).

The ECAM actions were carried out when the aircraft was climbing at a heavy weight, and due to the startle effect caused by the fire warning, the crew failed to notice that the speed reduced towards VLS.

The speed increased again after the descent had been initiated towards the diversion airport.

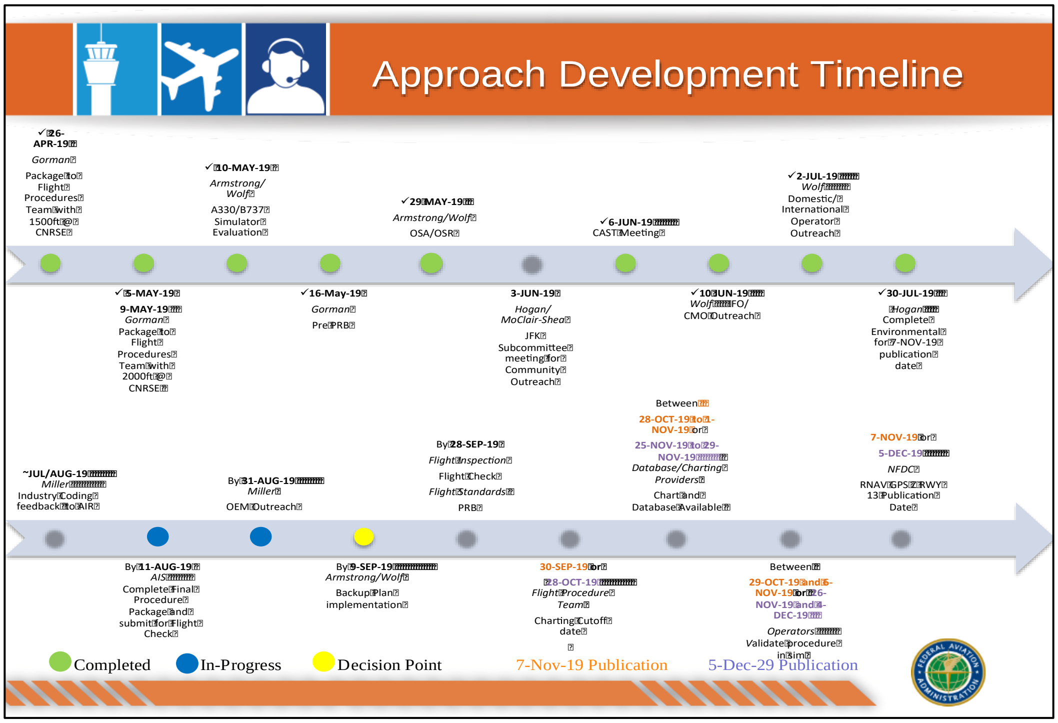


Lessons Learned / Comments

- The installation of the bearing compartment cover should be supervised – at the time it was considered a routine task
- The maintenance work-card was revised to include a leak check that must be performed prior to re-installing the engine exhaust cone. In this case the leak check was performed, however, with the exhaust cone installed, which visually hid the No. 5 bearing compartment cover
- Establishing an engine pairing policy is an important consideration
- Flightcrew training to include ENG fire and shutdown scenarios during cruise, not only at take-off, should be considered

7 CANARSIE APPROACH JFK

The presenting airline has been instrumental in the work to establish a new RNAV (GPS) procedure to runway 13L at JFK towards a possible Nov 7, 2019 publishing date.



Other operators have requested a similar approach to runway 13R to avoid long taxi and congestion at the airport. This discussion is on-going with the authorities who responded that the primary runway for landing is always 13L and that the tower almost never clears anyone for landing on 13R. The only landings they typically allow on 13R are when an aircraft lines up on final for 13R by mistake and when they determine it is easier and safer to re-clear it to land on 13R.

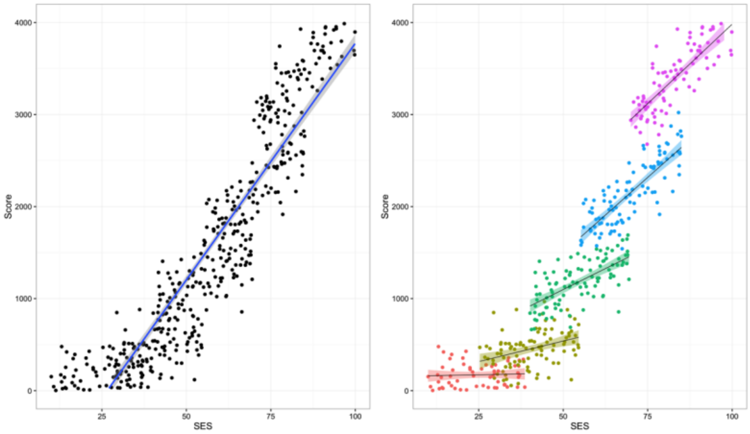
ATC has further agreed to keep the default setting for the lead-in lights on 13L, which sync up the electronic and visual guidance for landing only on 13L

8 ADVANCED FLIGHT DATA ANALYTICS IN SAFETY – CHANCES AND CHALLENGES

Advanced Flight Data Analytics in Aviation Safety

The Advanced Data Analytics Tools enable Airlines to holistically investigate coherences between multiple data sources, which include recorded flight data, fuel consumption, delays on the ground as well as pilot specific data, such as predicted and reported fatigue and roster details. Three major steps must be considered to ensure a successful implementation of the tool: the selection of meaningful analyses, the understanding of available data, and the translation of the stakeholders' requirements into tasks, which can be successfully implemented by IT-specialists.

Selection of Meaningful Analyses



Example of Multilevel Modelling (Source: Multilevel Modeling of Educational Data using R (Part 1) by Andrés Gutiérrez)

Safety Departments generally have a very good understanding of data structures and events attached to the development of the data. However, with the increasing complexity of data and the available analytics it is vital to dedicate adequate resources to identify fitting analyses. A clear understanding of what needs to be investigated, what kind of research has already been conducted, and what kind of data is available is the backbone of the entire process.

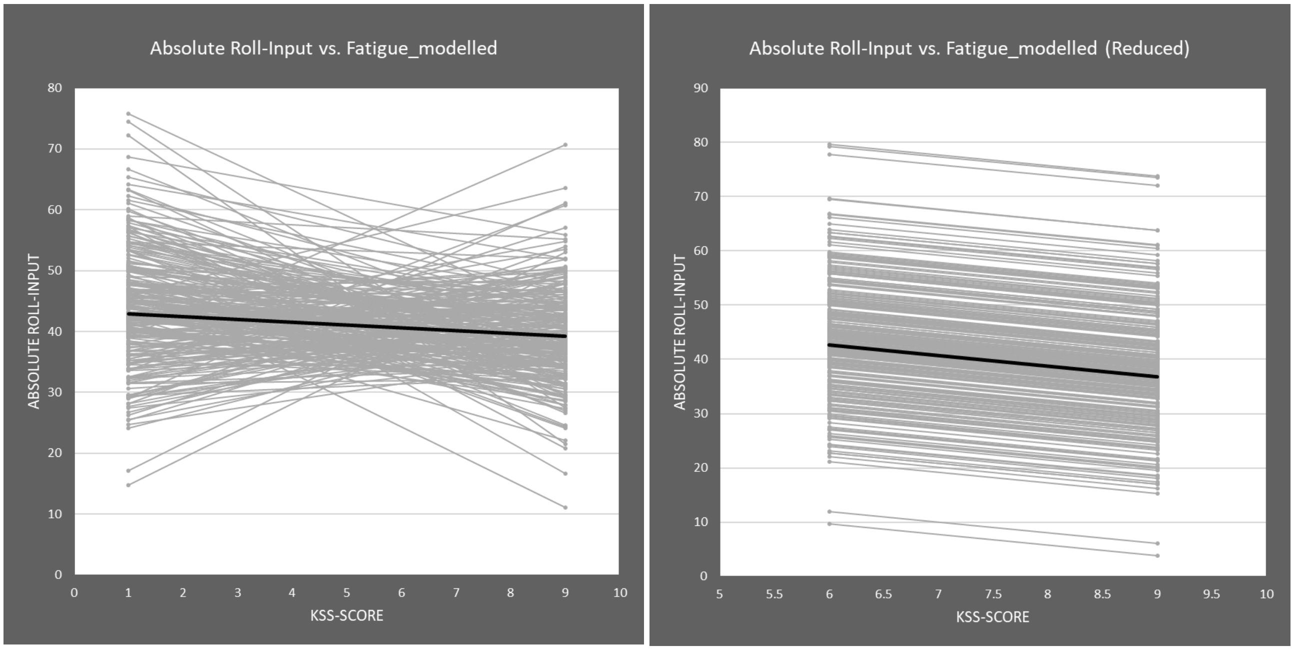
Understanding of Available Data

The data provided by aircraft, crews, maintenance and other areas within a company generally proves to be messy. Data management systems usually are not set up to provide the data a person is looking for in the best structure possible. A thorough review of data exports, their consistency and individual peculiarities (like missing data or a convoluted structure) is necessary to ensure a reliable and valid dataset, which reflects the airline's operation.

Translation of Requirements to Solutions

Regardless of the structure of a data analytics project, be it an internal small-scale investigation to better describe the nature of an event or be it an extensive implementation of a data analytics platform, the user and his or her requirements towards the tool are of utmost importance. Establishing a frequent communication with the person who will work with the analysis and the developer reduces misunderstandings, wrong requirements and disappointments during roll-out.

Results



The pictures above both show the influence of fatigue on pilots' roll-inputs. Left side includes all fatigue states (KSS = 1 to KSS = 9) where the model indicates that pilots tend to show individual responses towards increasing fatigue. In the diagram on the right, all KSS < 6 have been excluded. This reduced model shows that a higher fatigue seems to affect all pilots in a similar manner.

The three steps are not intended to be exhaustive. They should merely give an overview of what major steps must be considered when massive amounts of data shall be used for analytics. An example of a successful mass data analysis – dealing with the individual influence of fatigue on the manual flight performance of 643 pilots during 46,071 approaches – can be requested via christoph.hera@cargolux.com.

Lessons Learned / Comments

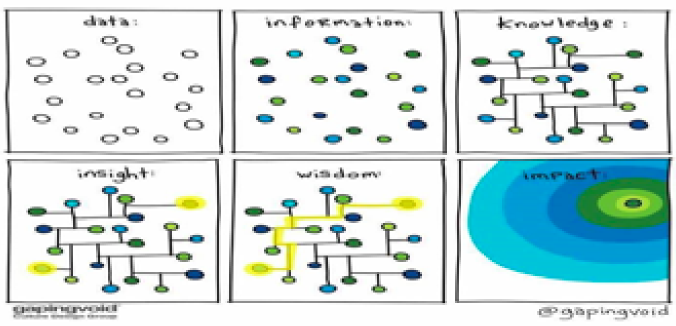
- Identify all necessary data sources and their structure before stepping into the development phase
- Interact intensively with internal (and if available) external experts to produce the best-case output

9 GLOBAL DATA INFORMATION, ISSUES, HAZARD SHARING AND ANALYSIS USING THE AVIATION DIGITAL HUB

The presentation explained the background to the Aviation Digital Hub (ADH) and its adoption as a platform to execute the creation of a Global Aviation Data Roadmap (GADR) for the industry to move through the Big Data space. It highlighted the breadth and depth of the platform and its ability to underpin industry collaboration. Examples of this are: Safety Performance Indicators (SPIs), moving from Safety I to Safety II and EBT/CBT. The 39 collaboration rooms already established on the ADH are compelling in their outreach and innovative potential. Of particular relevance to IATA is the Hazard Risk Management Group and the Global Hazard Data Sharing Initiative.

Collaboration among the principal stakeholders within the industry's digital transformation has never been more vital. One of the fundamental collaborative roads must be that of finding safe and secure means of sharing issues, hazards and data - big data, structured and unstructured, beyond the capability of traditional databases and software techniques. At IRM 25 in Hong Kong, side discussions took place regarding the development of a GADR to minimize duplication of effort, improve the focus and nurture innovation in digital transformation. It was felt that a roadmap was required, one that is agile and living through the medium and longer term (2030) serving the needs of all stakeholders.

Beginning with an Image of "Data"



Difference between data, information, knowledge, insight, wisdom and impact". Credit: gapingvoid

Initially there seemed to be no suitable means of collaborating efficiently on a global scale involving the appropriate expertise in developing a GADR. However, the Rolls-Royce SMS User Conference also took place in late October 2018. From here the idea of harnessing an Aviation Digital Hub (ADH) for establishing collaboration rooms to not only execute GADR but other data intensive collaborative activities such as SPIs, Safety II, EBT/CBT and Global Hazard Data Sharing (GHDS) initiatives took shape. The ADH has now been activated and twice upgraded by user feedback. There are now 39 collaboration rooms many of which address the likely focus areas of the GADR.

The ADH introduced during the presentation is the world's first commercial platform dedicated to fusing, enhancing and validating the world's aviation data.

Most relevant for the IRM participants is the Global Hazard Data Sharing initiative, which has the following objectives:

- To highlight hazards identified at stations and associated risks for awareness; mitigation strategies & control measures (preventive, detective, corrective) to reduce risks to ALARP (as low as reasonably possible)
- To drive operational safety through collaboration around this subject

10 USING DATA SCIENCE TO PREDICT RISK WITHOUT EVENTS

The presentation focused on three case studies based on the analysis of day-to-day large-scale data. Based on this analysis it is possible to quantify incident and accident probabilities within the following areas:

1. Controlled Flight into Terrain
2. Abnormal Runway Contact
3. Unstable Approach

Controlled Flight into Terrain

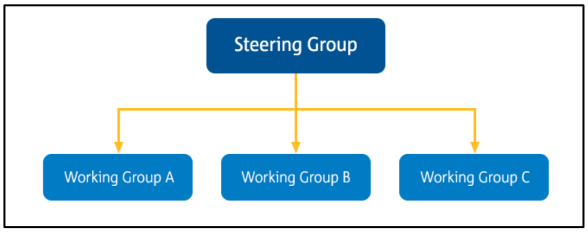
What is the problem?
The recorded data quality (sampling rate and detail) for the GPWS system is not sufficient to do predictive analysis. The occurrence rate for GPWS alerts is very low and with a low sampling rate, some might not even be recorded at all. Also, the alerts are recorded as binary parameters (1 – alert, 0 – no alert) having no information about the criticality of the situation.

What is the solution?
To simulate the GPWS system based on QAR latitude, longitude, altitude, heading, sinkrate and terrain data. Instead of only computing alerts, a computation of continuous metrics can be used for predictive analysis. The presenter proposed a virtual time-to-impact as a metric, that assumes no further control inputs are given.

The CFIT study is based on the work conducted by the EOFDM forum, which is a voluntary partnership between European Operators and the European Aviation Safety Agency (EASA) in order to:

- Facilitate the implementation of Flight Data Monitoring (FDM) by Operators
- Help operators draw the maximum safety benefits from an FDM Program

A steering group leads the EOFDM, which oversees three Working Groups (WGs). Working Group A (WGA) deals with operational safety issues, WGB deals with programming and equipment related aspects and WGC deals with the integration of the FDM program into an operator's processes.



One of the current risk areas addressed by WGA is CFIT, and a current topic for WGB is the definition of algorithms to integrate Terrain Databases with Flight Data.

The objective of the WGA analysis is to identify among the precursors of CFIT scenarios the ones that are suitable for monitoring through an Operators' FDM. Those identified precursors will then be publicly available to Operators and aviation communities for further consideration, in particular to orient the update of their FDM systems. In addition, they are provided to EOFDM WGB who gathers and develops industry FDM best practices for the design and coding of events, capturing such precursors.

The analysis of WGA is structured into two sequential steps. The first step aimed at identifying CFIT precursors based on existing analysis material of CFIT scenarios across the industry communities. This enables a data driven approach for the identification of CFIT precursors as it relies on the existing safety analysis performed by worldwide aviation stakeholders based on official safety investigations or other safety data available.

In a second step, the main precursors for CFIT scenarios are collected and the ones most capable of being captured and monitored through FDM programs are identified:

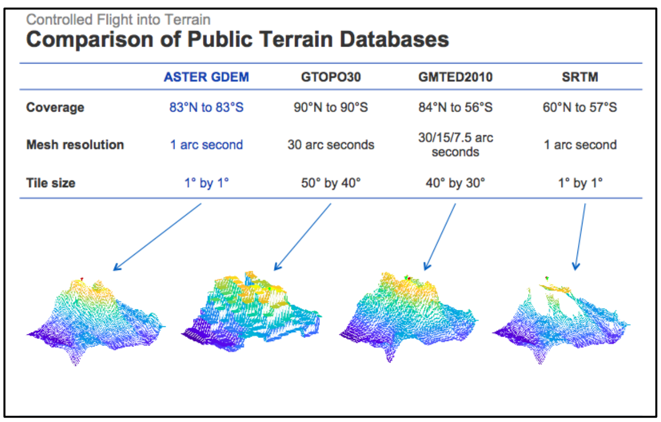
- Poor visibility
- Altimeter errors
- Lateral and/or vertical deviation from intended flight path
- TAWS alerts
- Loss of terrain separation

Each precursor is analysed to define the best strategy to monitor/capture them via FDM programs.

Knowing the position and altitude of the aircraft is important to start CFIT precursor monitoring. Aircraft parameters that are required for monitoring are:

- Latitude and Longitude of the aircraft position
- Geometrical altitude of the aircraft above mean sea level and above ground
- Three-dimensional speed vector of the aircraft

To investigate the proximity of a scenario regarding a CFIT accident, information about the underlying and surrounding terrain is necessary. Combining the aircraft parameters with the relationship to terrain, as well as actual versus published flight paths (SIDs/STARs) can help detecting precursors to CFIT.



The problem with classical FDM data is low sampling rates and single bit sources, which results in unreliable CFIT data. The solution is to use a terrain database and position and velocity data instead of recorded CFIT alerts. There are various terrain databases publicly available.

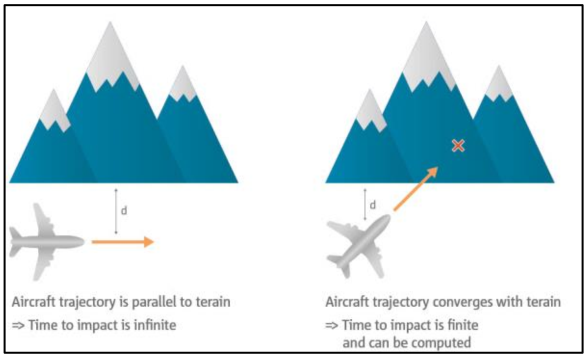
In order to derive the vertical distance of the aircraft to the underlying terrain, only the reconstructed position and geometrical altitude is necessary. The characteristics of the chosen terrain elevation model influences the estimated vertical distance to terrain. Especially in rough terrain or for terrain models with coarse grid spacing, interpolation between different model points is necessary to obtain good results.

Once the vertical distance to terrain is obtained based on the terrain database data and the aircraft position and geometrical altitude, it can be compared to the recorded radio height (for situations in which this is valid, e.g. below 2,500 feet above ground level. This comparison can be used to assess the plausibility of the terrain database.

Precursors to be monitored

CFIT Precursors				
Precursor	**Description**	**External Data Sources**		
		Terrain	**Weather**	**Navigation**
CFIT01	Poor visibility condition	No	Yes	No
CFIT02	Wrong altimeter settings	No	Yes	No
CFIT03	Flight below MSA	Yes	No	Yes
CFIT04	Deviation below glideslope	No	No	No
CFIT05	FMS incorrectly set	No	No	Yes
CFIT06	Inadequate vertical mode selections on AFCS	No	No	No
CFIT07	Incorrect descent point	No	No	No
CFIT08	Incorrect TAWS escape manoeuvre	Yes	No	Yes
CFIT09	Inadequate missed approach and go-around flight path	No	No	Yes
CFIT10	Loss of communication	No	No	No
CFIT11	Low energy state during apprach / unstable approach	No	No	No
CFIT12	Inadequate response to windshear warning	No	No	No
CFIT13	Reduced horizontal distance to terrain	Yes	No	No
CFIT14	Reduced time to terrain impact	Yes	No	No

For the reduced time to terrain impact precursor, the three-dimensional speed is used in addition to the three-dimensional position. In fact, neither the vertical distance nor the horizontal distance to terrain are crucial for the occurrence of a CFIT but are useful to categorize the scenario. What is important is distance plus the speed and direction vector. Based on the current three-dimensional position of the aircraft together with a three-dimensional speed vector, a "virtual" Time to Terrain Impact can be calculated. The underlying assumption for this calculation is that the speed vector stays constant until the "virtual" CFIT occurs.



In this scenario it is assumed that an aircraft is flying along a mountain range such that the three-dimensional speed vector is parallel to the mountain range. Even if the distance between the aircraft and the cliff is small, this implies that the Time to Terrain Impact is infinite. Nevertheless, for the same horizontal distance to terrain, the situation becomes more critical if small changes of the speed vector towards the mountain range occur. This situation should be covered by this precursor. Also, what it means to significantly reduce time to impact has to be researched in order to define such a precursor and, in particular, a suitable time threshold.

Lessons Learned / Comments

- Only looking at data is not enough to judge CFIT scenarios. You need to merge with further data sources and build models to measure the criticality of situations.

CFIT Recommendations by WGA

- Poor visibility condition: Develop means to identify present visibility conditions (e.g. IMC or VMC)
- Wrong altimeter settings: Develop means to identify wrong altimeter settings
- Flight below MSA: Develop means to identify situations of aircraft flying below MSA
- Deviation below glideslope: Develop means to identify (severe) deviations below glideslope that increase CFIT risk
- FMS incorrectly set: Develop means to identify errors in FMS settings, especially those associated to close to terrain operation (e.g. approach in a mountainous area)
- Inadequate vertical mode selections of AFCS: Develop means to identify inadequate vertical mode selections of the aircraft flight control system, especially those associated to close to terrain operation (e.g. approach in a mountainous area)
- Incorrect descent point: Develop means to identify incorrect descent points
- Inadequate TAWS escape manoeuvre: Develop means to identify escape manoeuvres after a triggered TAWS alert that are non-compliant with the correct manoeuvre or airline SOPs. And beyond that, approaches with repeated TAWS soft warnings (or just one TAWS warning) should be monitored. Repeated TAWS soft warning during an approach can evidence that either the aircraft was not safe with regards to the terrain potentially due to the approach procedure design, or that the TAWS needs to be adjusted for that particular approach
- Inadequate Missed Approach and Go Around flight path: Develop means to identify Missed Approaches and Go Around flights paths that are noncompliant with published information or airline SOPs
- Loss of communication: Develop means to identify loss of communication
- Low energy state during approach / unstable approach: Develop means to identify low energy states during approach and unstable approaches
- Inadequate response to wind shear warning: Develop means to detect inadequate responses to wind shear warnings, especially in situations close to terrain (e.g. approach in a mountainous area)
- Reduced horizontal distance to terrain: Develop means to identify scenarios of reduced horizontal distance to terrain
- Reduced time to terrain impact: Develop means to identify scenarios of reduced time to terrain impact assuming the aircraft maintains current track and speed

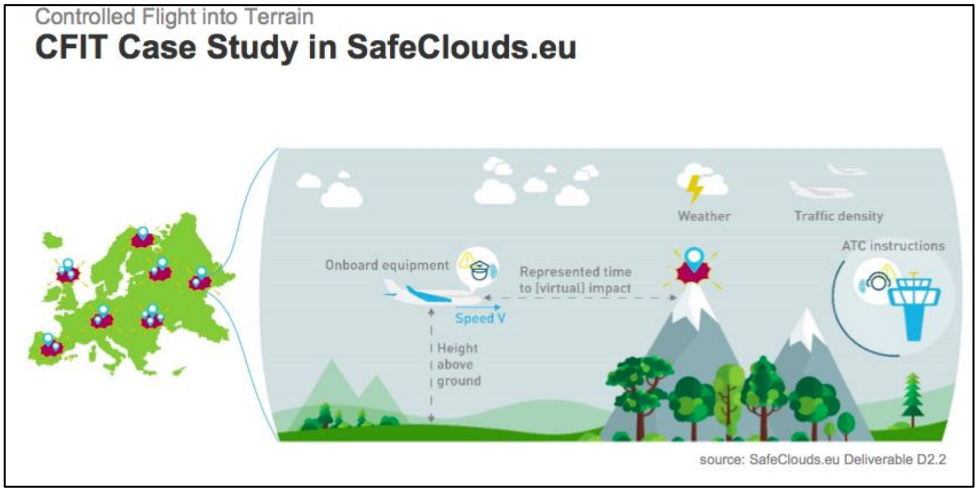
Each recommendation identified by WGA, corresponds to a possible precursor for an incident or accident related to CFIT, which have been addressed by WGB.

SafeClouds project

SafeClouds is one of the few data-related projects addressing aviation challenges. It was launched in October 2016 for duration of 36 months.

SafeClouds is born with the aim of paving the way towards a new paradigm, where aviation safety is primarily based on data and data is more actively shared. The more data shared, and the smarter the techniques, the more secrets it can reveal. Some patterns only emerge when the data is properly analysed.

Some systems only reveal their underlying dynamics when the picture is complete. With this goal in mind, SafeClouds counts on the support of EASA and a full spectrum of aviation stakeholders (airlines, airports, air navigation service providers, Eurocontrol, research entities and safety agencies).



The resulting and unprecedented co-ordination of datasets will make it possible to apply new data science tools to aviation safety, it will make it possible to have the complete system.

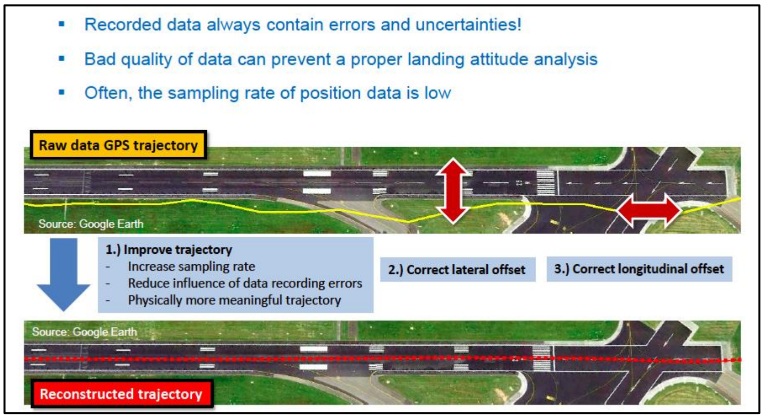
Abnormal Runway Contact

What is the problem?
The sampling rate and quality of direct QAR data is insufficient to do a meaningful landing attitude analysis, even defining the touchdown point is hard.

What is the solution?
The presenter proposed an algorithm in the past for “landing reconstruction”, which uses all available sources with information about the aircraft location and attitude (e.g. GPS + IMU + LOC/GS) to reconstruct a high-fidelity landing trajectory at 8-16Hz. Based on the cleaned and smoothed parameter timeseries and information about the aircraft geometry (from the manual), it is possible to analyse the attitude at critical points and to generate reports in the form of “angle margin to tail/wing strike” or “time margin to strike”, either statistically for the fleet or for individual flights.

Lessons Learned / Comments

Raw data quality from the QAR is bad and can lead to wrong decisions if trusted too much. Combining the data with physical models yields more reasonable results that are physically motivated and allow for more accurate studies



Unstable Approach

What is the problem?
The concept of out-of-bounds parameters used as a trigger for safety events might is too limiting to do predictive analysis.

What is the solution?
In SafeClouds an extensive labelling pipeline was built to mass-label approaches in QAR data based on numerous factors, including METAR and RADAR data. A continuous metrics for each approach is computed to facilitate predictive analysis.

Lessons Learned / Comments

- The landing phase is too complex with all its decision making, configuration changes and influence from the environment to be reduced to simple parameter thresholds.

11 HOW PILOT ROLE ASSIGNMENT INFLUENCES DECISION-MAKING UNDER UNCERTAINTY: A BEHAVIOURAL AND EYE-TRACKING STUDY

The presentation introduced the results from a study into how decision-making is influenced by pilot role assignments.

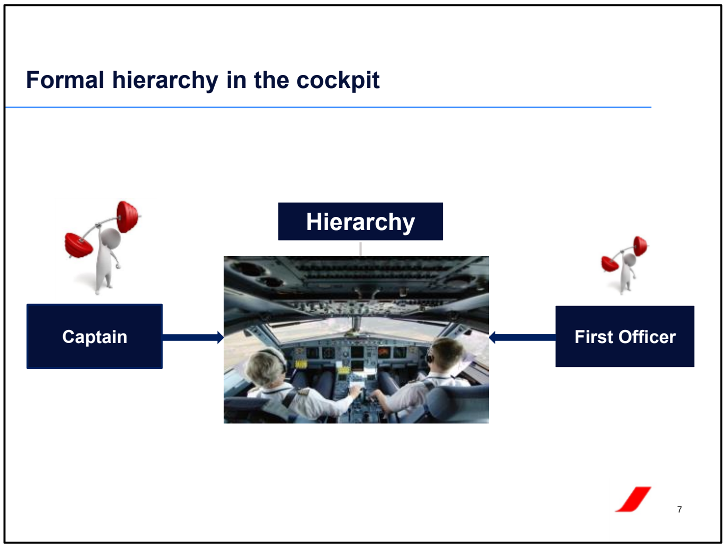
Pilots are highly trained individuals with a routinized and standardized behaviour guided by checklists and procedures, which is influenced by teamwork and hierarchy. An added factor is a high time pressure environment where decisions can have a life or death outcome. According to Flight Safety Foundation, no other single decision can have such an impact on the aviation accident rate since 83% of runway excursions could have been avoided with a decision to go-around.

The study focused on variations in decision making during unstable approaches with the Captains and First Officers alternating between the roles as Pilot Flying (PF) and Pilot Monitoring (PM).

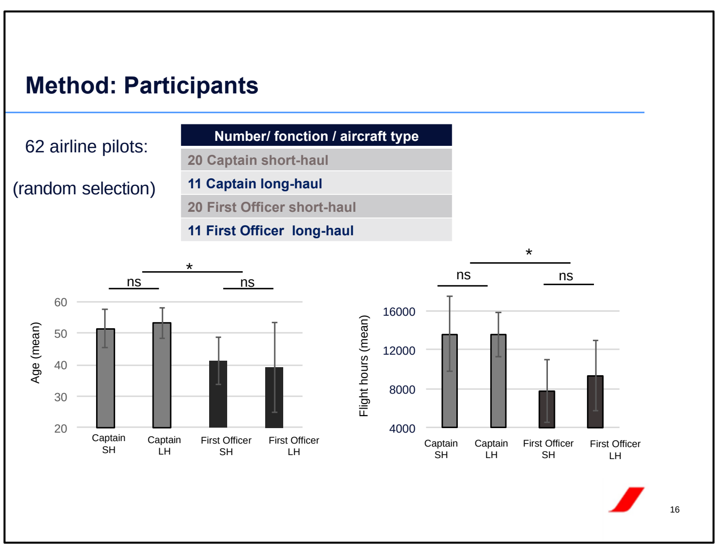
The unstable approach scenario was chosen since research has shown that 97% of all unstable approaches are continued to a landing, contrary to airline Standard Operating Procedures (SOPs).

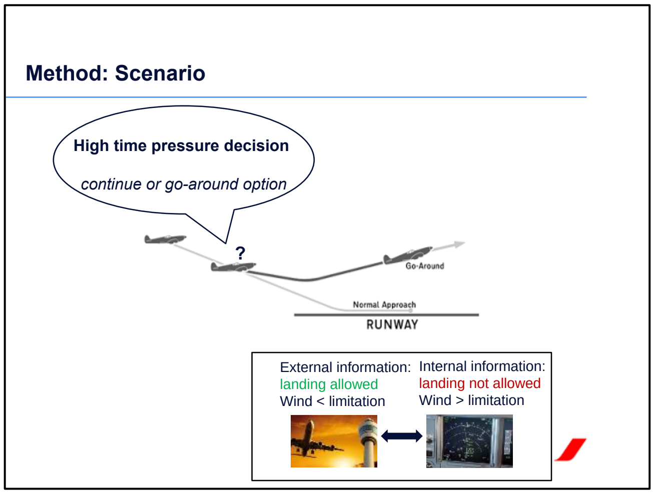
The purpose was to see how social factors; hierarchy and role assignment affected the decision to go-around or to continue the approach to landing.

Both the Captains and First Officers were allowed to make the go-around call when the approach became unstable.

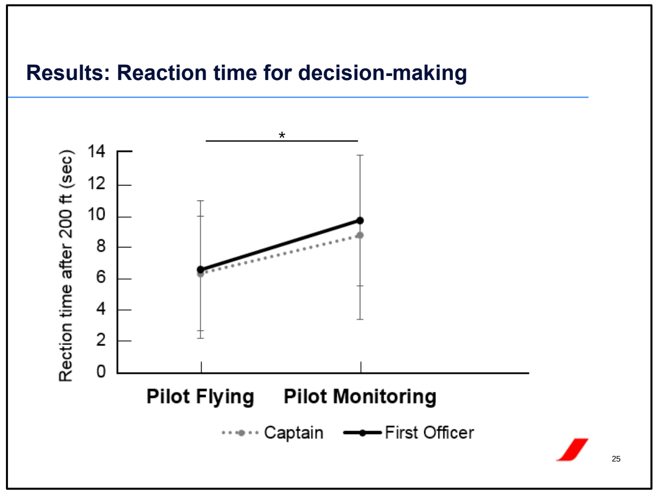


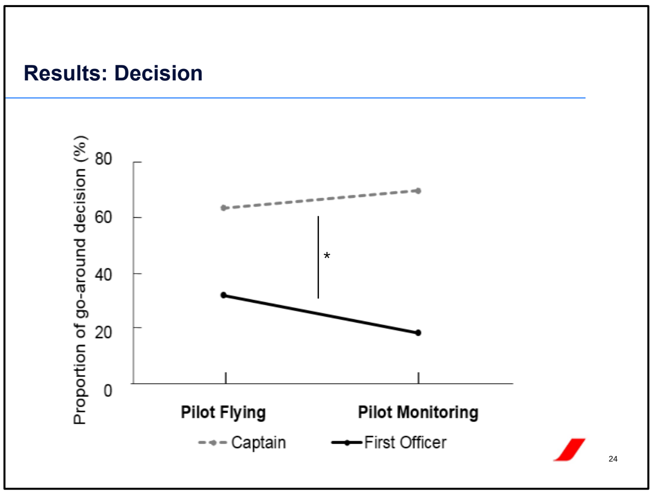
62 pilots participated in the study with a mix of short-haul and long-haul pilots. The test subjects were equipped with Tobii Pro Glasses 2 wearable eye-trackers to track eye movement.



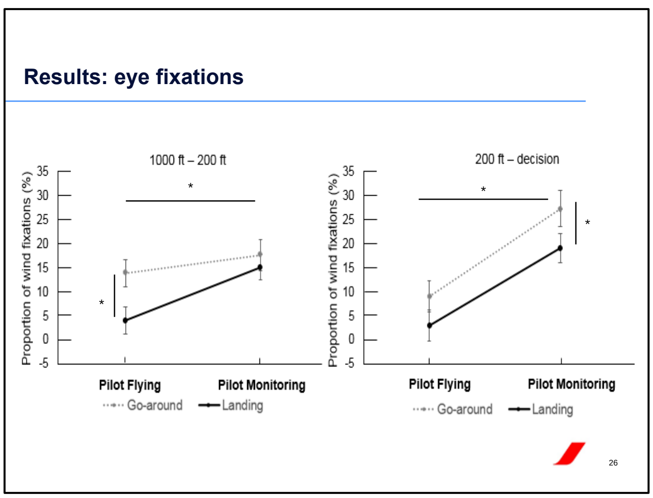


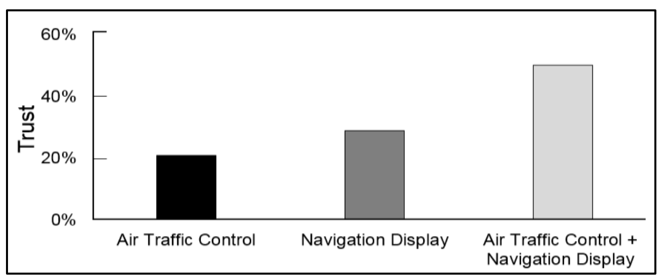
In the scenario, the pilots were placed in a high time pressure decision situation where the external wind information from the tower permitted a continued approach but where the internal Navigation Display (ND) wind information exceeded limitations.





The results showed that the go-around decision made by the Captain was overall proportionally higher than for the First Officer. Also, when the Captain was PM, the decision to go-around was proportionally higher than when the Captain was PF. The reverse was true for the First Officer. The reaction time for decision-making was about the same for both the Captain and First Officer, but shorter if they acted as PF. The eye fixation on internal wind information was higher for the PM and higher for go-arounds





Both the Captains and First Officers tended to trust the combined wind information from ATC and ND.

Lessons Learned / Comments

- Pilot role assignment impacted the decision moment, whereas hierarchy impacted the decision itself
- The PM fixated more overall on the decision-relevant information
- Tendency: A monitoring role for the First Officer seems to be problematic when he/she has to switch away from the landing option
- Fixations on decision-relevant information could predict decision-making

Propositions

- In situations that are not completely covered by procedures, a clear briefing between both pilots should be performed before starting the approach. Both pilots should clearly define and share a decision strategy
- Based on the company's culture and procedure policy, a possible interaction of hierarchy (Captain vs. First Officer) and role assignment (in command vs. monitoring) should be taken into account at training levels. For example, training should emphasize the active role of the PM (in particular for the First Officer) for decision-making
- Since the PF is mainly concentrated on flying the aircraft during final approach, the PM should communicate only relevant actions rather than repeating technical information that has to be processed by the PF

12 A321 – ALTITUDE DEVIATION AND STARTLE EFFECT IN SEVERE TURBULENCE

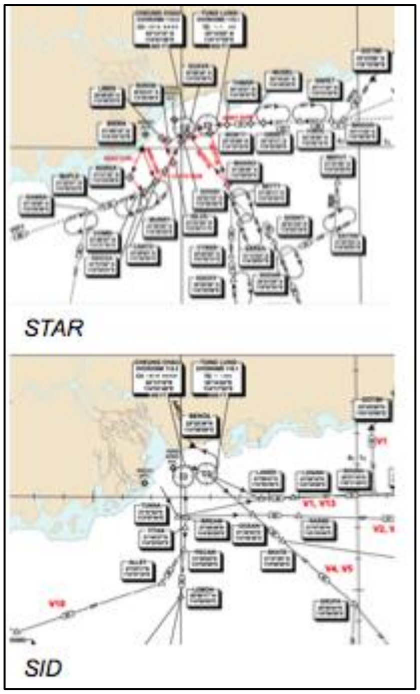
An Airbus A321 encountered severe turbulence shortly after take-off from VHHH when levelling off at FL210. The turbulence resulted in an altitude deviation and the activation of the Angle of Attack (AOA) protection on two separate occasions.

Severe turbulence is defined as turbulence, which causes large and abrupt changes in altitude and/or attitude.

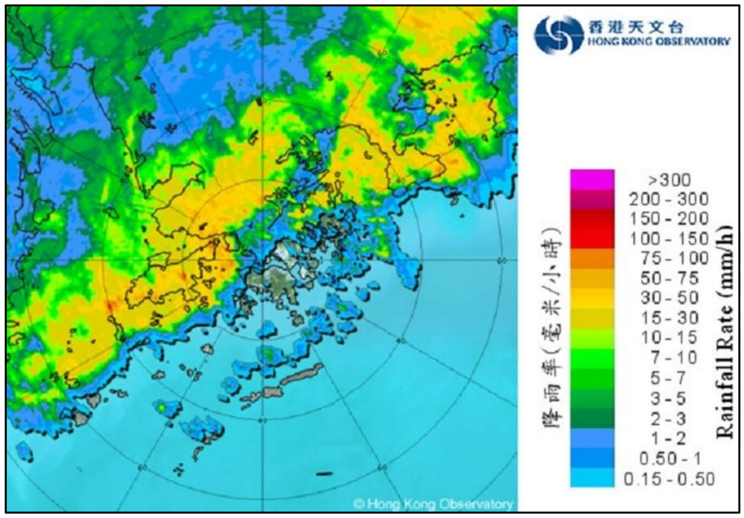
Airbus FCOM Procedures for Severe Turbulence encounter

- If encountered, the flight crew should:
    - **Keep the autopilot on,** when thrust changes become excessive disconnect Autothrust
    - Adjust the speed and thrust per the table in the QRH
    - Consider descent to, or below, the optimum Flight Level

- If the aircraft is flown manually
    - The flight crew should avoid the temptation to fight turbulence and should not over-control the sidestick. (Control laws are designed to cope with turbulence)
    - The flight crew may expect large variations in altitude **but should not chase altitude**

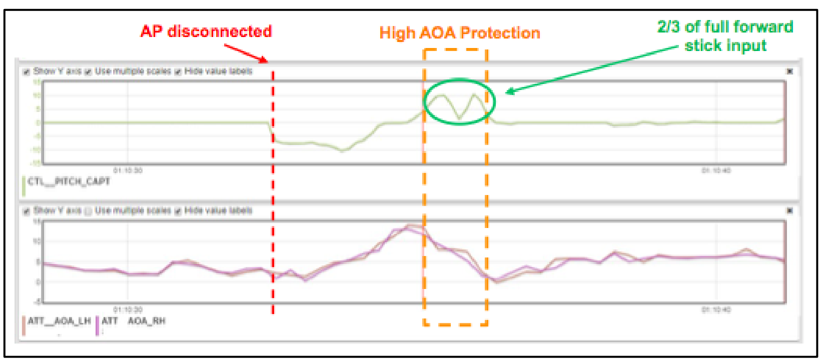


VHHH is located in a high-density traffic area with frequent convective weather activity and CB encounters. Radio frequency congestion makes heading requests to ATC difficult to make in a timely manner. In addition, the airspace structure results in intersecting departure and arrival tracks with frequent level-offs for both departing and arriving traffic.

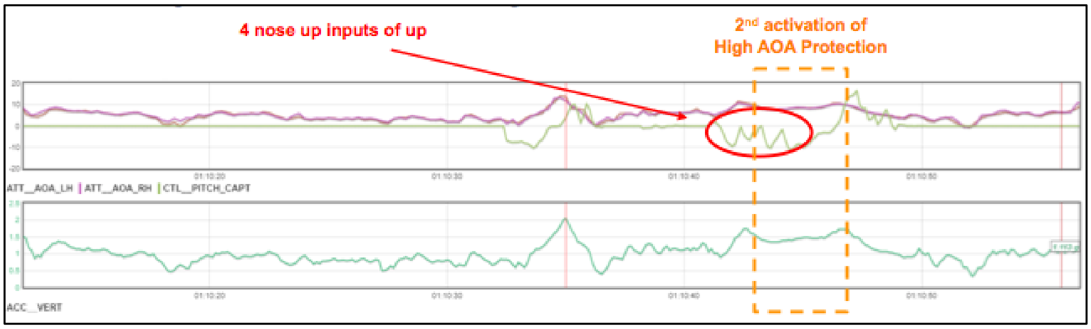


Shortly before take-off a band of intense thunderstorms with frequent lightning, heavy rain and severe squalls with gusts exceeding 54 knots swept across the area. Due to the weather, the flight was delayed 25 minutes.

An updraft occurred when the flight was levelling off at FL120, which resulted in an overshoot of the cleared FL by 210 feet. The Autopilot (AP) aggressively corrected the deviation within 19 second, which resulted in a recorded rate of descent of 3,300 feet per minute. To avoid a second altitude deviation, the PF disengaged the AP by applying a 2/3 nose up stick input. The stick input increased the aircraft pitch from five degrees nose down to zero degrees, which led to a vertical acceleration increase from +0.6g to +2.0g and the activation of the AOA protection. Almost immediately after the activation of AOA protection, the PF applied a 2/3 forward stick input, which deactivated the AOA protection.



The sum of both back and forward stick inputs partially cancelled each other out and the aircraft continued to descend 724 feet below the cleared FL. To recover from the descent, the PF applied nose up stick inputs, which led to a significant vertical acceleration increase and a second activation of the AOA protection. The PF deactivated the AOA protection by applying a nose down stick input. Shortly thereafter, the crew re-engaged the AP.



During the turbulence encounter, up to 40 degrees left and right roll oscillations were also experienced with and without the autopilot engaged.

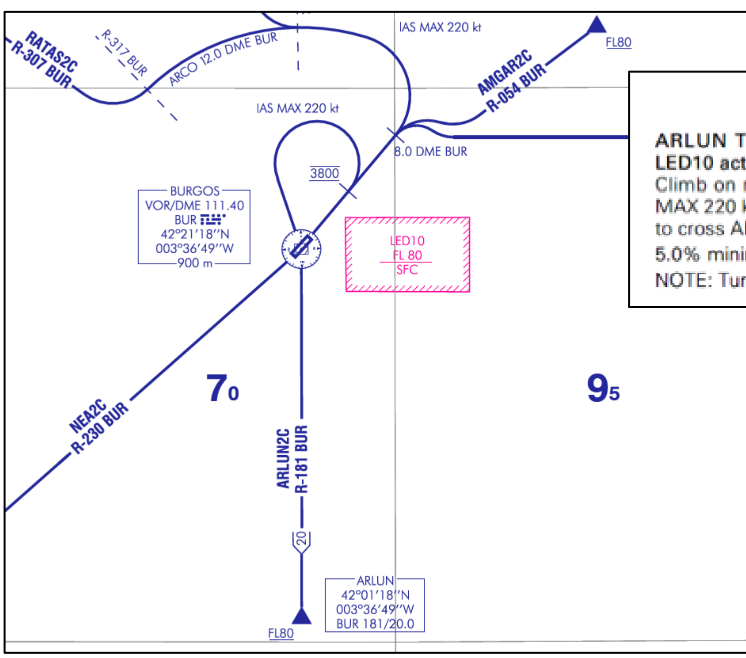
The flightcrew were aware of the Airbus turbulence FCOM procedures, however due to the Startle Effect, the PF's immediate reaction was to disengage the AP and attempt to recover from the altitude deviation manually.

Lessons Learned / Comments

- It is important that all flightcrews have an awareness of Airbus aircraft protection systems
- Crew awareness of the severe turbulence procedures is important
- Crew understanding of the control laws of fly-by-wire aircraft is important

13 ISSUES WITH CHARTING CONVENTIONS

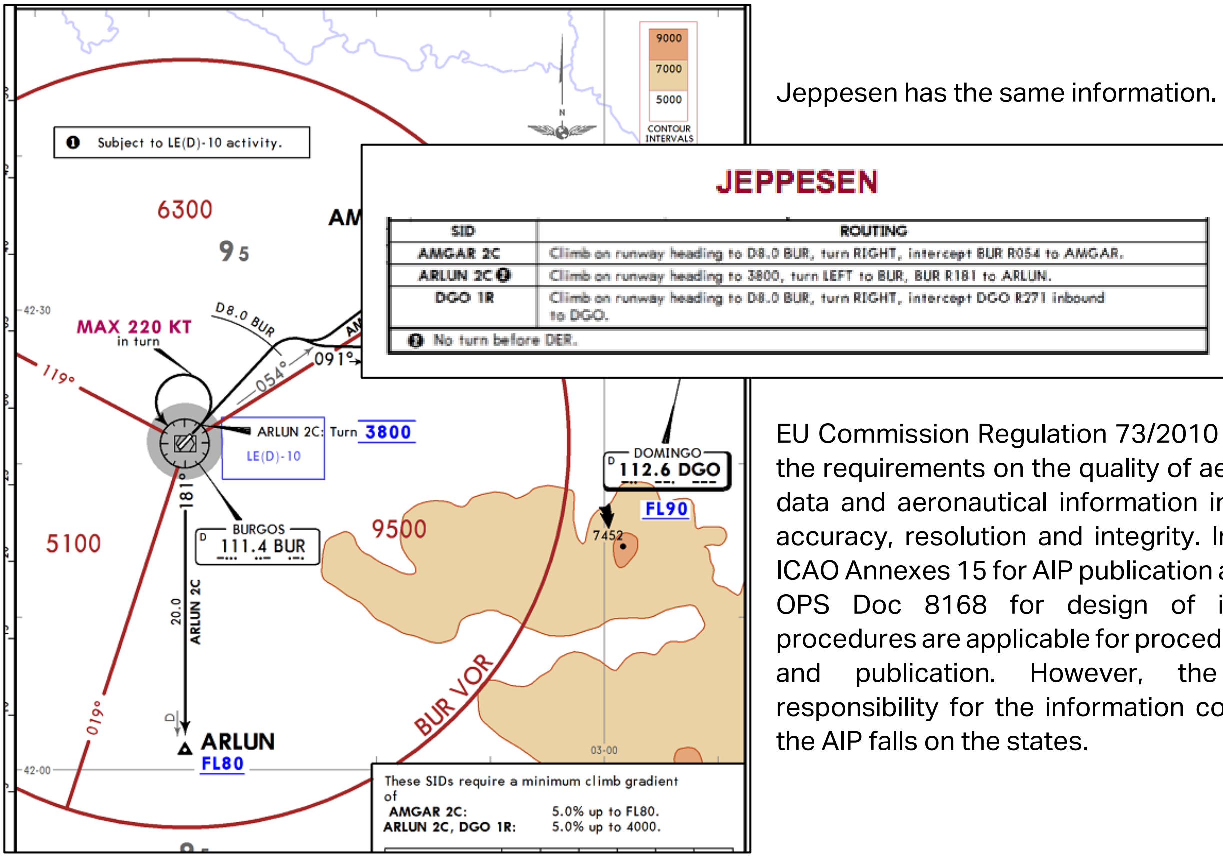
The presentation focused on the misuse of charting conventions in the AIPs and used SID ARLUN 2C to illustrate the issue.



AIP

ARLUN TWO CHARLIE DEPARTURE (ARLUN2C). Subject to LED10 activity.
Climb on runway heading to reach 3800 ft. Turn left (turning IAS MAX 220 kt) direct to VOR/DME BUR. Proceed on R-181 BUR direct to cross ARLUN at FL80 or above.
5.0% minimum climb gradient to 4000 ft.
NOTE: Turning before DER is not allowed.

The AIP lateral view shows a mandatory altitude of 3,800 feet during turn, but no additional climb information. The descriptive text states that the turn commences at 3,800 feet but does not state if this altitude is to be maintained. When does the climb to FL80 begin?



Jeppesen has the same information.

EU Commission Regulation 73/2010 lays down the requirements on the quality of aeronautical data and aeronautical information in terms of accuracy, resolution and integrity. In addition, ICAO Annexes 15 for AIP publication and PANS-OPS Doc 8168 for design of instrument procedures are applicable for procedure design and publication. However, the ultimate responsibility for the information contained in the AIP falls on the states.

Responsibilities also falls on:

- Organizations that provide information (data originators) on which the charts are based
- Organizations that design the procedure
- Organizations that publishes the charts in the AIP

When EU Commission Regulation 2017/373 comes into force 2020 and repeals Regulation 73/2010 it will change the regulatory framework, requiring AIP service providers to be certified and subject to state oversight. Aeronautical information service providers shall ensure the integrity of data and confirm the level of accuracy of the information distributed for operations, including the source of such information, before such information is distributed. Therefore, the responsibilities on the services and on the oversight will be much clearer.

Lessons Learned / Comments

- AIP and chart provider information can be misleading
- There is a need for an airport hazard registry to share information

14 LEARNING AND IMPROVEMENT TEAM

Advances in commercial aviation have made the system more and more complex. Crew resilience has become integral and critical to flight safety as well as efficiency. The presenting airline has established the Learning and Improvement Team (LIT) to implement Safety II in flight operations. Items presented were a brief history of the airline's LIT journey, methodology in developing the LIT model and measurable metrics, and the implementation of various data collection tools to collect data for analysis.

The presentation showed how the LIT has found a way to explore and document strengths and patterns during normal work conditions that falls within the Safety II framework and moves away from the traditional reactionary safety work towards incidents and SOP deviations.

The team developed a model to understand why success is the rule and not the exception and based it on the assumption that safety is not about the absence of negatives but the presence of resilience, the capacity to recover from difficulties and changing parameters.

	Safety-I	Safety-II
Definition of safety	That as few things as possible go wrong	That as many things as possible go right
Safety management principle	Reactive, respond when something happens	Proactive, try to anticipate developments and events
Explanations of accidents	Accidents are caused by failures and malfunctions	Things basically happen in the same way, regardless of the outcome.
View of the human factor	Liability	Resource

15 B737 – RUNWAY EXCURSION

During landing in Trabzon (LTCG) at night in light rain with 4,000 metres visibility, a B737-800 ran off the left side of the wet runway and slid down a cliff towards the Black Sea. The aircraft came to rest in a precarious position along the side of the cliff with the nose of the aircraft facing the sea below. The aircraft was prevented from sliding into the sea due to the ground being wet and the landing gear being stuck in the muddy ground. All passengers and crew evacuated safely with no injured, but the aircraft sustained substantial damage.

The accident is still under investigation by the National Accident Investigation Board, but the internal investigation has been completed with the following points presented and discussed:

- The ILS approach was stable at 1,000 feet agl and continued without any issues until ILS minimums

- There were two HOLD items prior to flight:
    1. Engine No. 2 Thrust Reverser, and
    2. HF Radio

  The mechanically locked Thrust Reverser, which meant that the lever was locked in a closed position, was discussed during the approach briefing

- A significant thrust asymmetry occurred when both TO/GA switches were pushed instead of the Autothrottle (A/T) disengage buttons, which led to the right engine developing TOGA thrust with the left engine in reverse during the landing rollout

- A contributing factor was the use of dual autopilots during approach, which resulted in an automatic nose up trim in anticipation of a go-around. The sudden pitch up moment when the autopilot was disengaged caused some disorientation

Lessons Learned / Comments

- According to current recommendations, the final approach is to be flown with the A/P and A/T disengaged so that the pilots can improve their manual flying skills. During the final approach phase where the flight has reached the highest level of threats, the A/T and A/P disengage actions are open to human errors. Pressing the TO/GA switch by mistake is one example of these human errors.

- When the Thrust Reverser is on HOLD, the corresponding Thrust Reverse Lever is tied by wire according to the Aircraft Maintenance Manual. This leads to pilot actions they are not accustomed to when using thrust reversers after landing. An extra mental effort is required to use the active thrust reverse lever on its own. During this attention shift the thrust lever on the engine with the thrust reverse on HOLD may be left out of hand control. Instead of connecting the lever with a wire in the case of HOLDs, it is recommended for Boeing to evaluate the application of a design, which permitts the movement of both thrust levers.

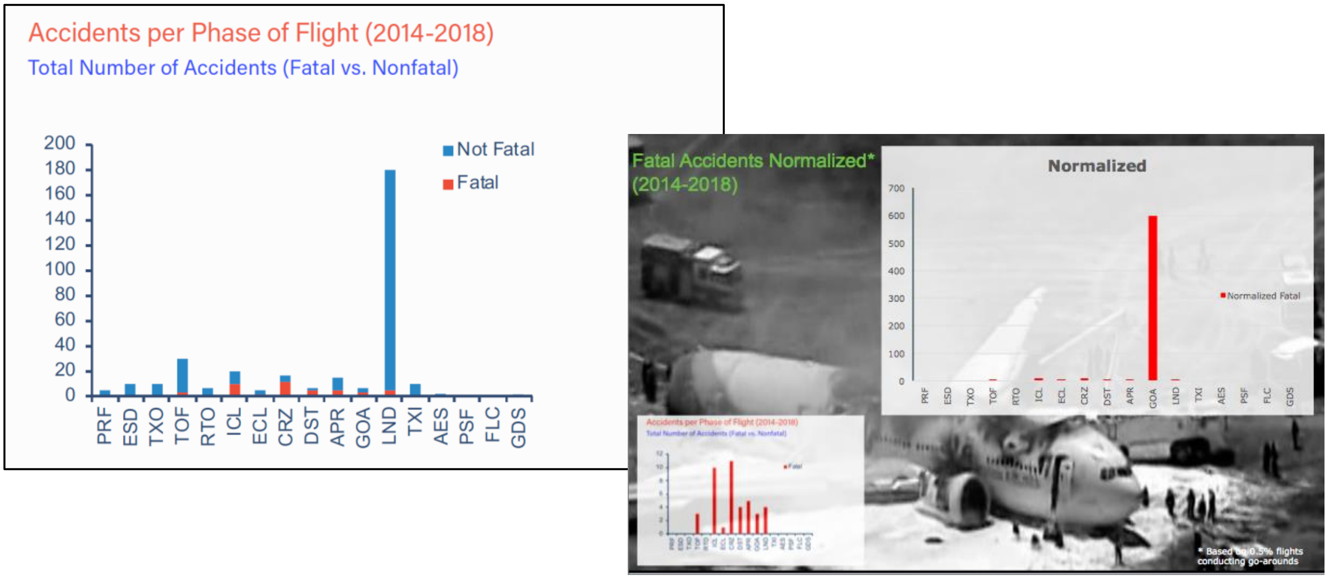
- As written in the Boeing FCOM, Autothrust (A/T) disengages automatically two seconds after touchdown. It should be clearly stated in the Boeing FCOM and FCTM that this condition is not valid in the A/T GA mode. In addition, even in the case of landing with A/T GA mode, it is recommended for Boeing to evaluate whether A/T should be automatically disengaged if a thrust reverser is deployed.

Internal Actions Taken

- Face-to-face meetings with all related department managers have been held to identify improper management systems which may cause future incidents
- Studies have been initiated to take steps to make the quality of Flight Crew Training even better
- New extensive flight safety precautions have been studied, decided and published to all flight crew
- Critical HOLD Items studies have begun, to take quick action on HOLD items critically affecting flight safety
- CAT I approaches will be accomplished with single autopilot; dual autopilot will be used only in CAT II/III LVP conditions
- Autopilot (Boeing and Airbus) and autothrottle (Boeing) will be disengaged at minimums for IMC conditions and latest at 1,000 feet agl in VMC conditions if the runway is insight
- If the TO/GA button is pressed inadvertently on Boeing aircraft below 1,000 feet agl, a go-around should be initiated regardless of aircraft position
- Night flights will not be planned for airports not equipped with functioning PAPI/VASI systems unless an ILS is available
- Captains will be PF if the crosswind exceeds 20 knots, visibility is less than 1,000 metres, ceiling is below 500 feet and if HOLD items affect landing performance

16 STABLE APPROACH, LANDING AND GO-AROUND POLICIES VERSUS IOSA STANDARDS

Approach and Landing accidents are the most common accidents, however Go-around accidents are the most fatal, if measured as rate of flight per flight phase. Go-around policies are in place to prevent the most common accident type, but they direct flights to enter into the most fatal phase of flight and have extremely low compliance. Efforts to improve compliance have made little impact.



The presenting airline's SMS evaluation determined that the low go-around policy compliance status was unacceptable and launched the Stable Approach, Landing and Go-around (SALGA) project to come up with a solution to the problem. The project lasted for over two years and involved Management, Line Pilots, Pilot Association, Regulator and external expertise.

Phase one of the project included research and analysis where pilot and management groups evaluated the current policies and practices, conducted external studies and determined findings and proposed recommendations.

Phase two of the project lasted several months. During this phase, two working groups, involving all interested parties, convened and developed new procedures and policies, based on the findings and recommendations from Phase one. These new procedures and policies were then tested in phase three, during simulator and line trials. One significant change in the procedures and policies was the introduction of a 200 feet AAL (Aircraft Approach Limitation) approach stabilisation gate set as a limit.

Phase three simulator trials were conducted with 60 participating pilots, randomly selected from six aircraft types. These pilots conducted 300 evaluated approaches in varying degrees of Approach and Landing stability.

The goals of the line trials were to test the efficiency of the new procedures, to monitor unanticipated safety issues, to detect weaknesses and to make necessary adjustments.

New Stable Approach & Go-around Policies / Procedures Overview

- The new policies distinguished stable approach **goal-targets** from **limits**
- The Stable approach goal-altitude was raised to promote earlier configuration
- The Go-around Policy altitude limit was lowered to realistic and safe altitudes, which allows for airmanship
- More active communications: mandatory, repeated and escalated

New Stable Landing & Go Around Policies / Procedures Overview

- Distinguished a Stable Optimum Touchdown Zone (OTZ) Landing **goal** from **limits** – Touchdown Point Limit (TPL) and Landing Touchdown Point Limit (LTPL)
- Program Manager assigned to monitor for OTZ execution, TPL and LTPL passage
- More Active communications: mandatory, repeated and escalated
- Compliance Metrics and Targets to be set, reviewed at corporate safety boards

Lessons Learned / Comments

- No decrease in safety with a 200 feet approach stabilisation gate
- Significant improvement in situational awareness
- Readiness to conduct a go-around improved
- Significant reduction in go-around exposure
- Initial resistance from flight crews during the learning period
- Very high pilot agreement by the end of trial
- Regulator publicly endorsed the new procedure

Implementation of the new procedures is targeted for the end of 2019. Even though the regulator has approved the new procedures, implementing these procedures would mean non-compliance with an IOSA standard.

ICAO
The elements of a stabilized approach (according to the parameters in 3.2) *shall* be stated in the operator's SOPs. These elements *should* include as a minimum:
a) that in instrument meteorological conditions (IMC), all flights shall be stabilized by no lower than 300 m (1000 ft) height above threshold; and
b) that all flights of any nature shall be stabilized by no lower than 150 m (500 ft) height above threshold.

IATA
The Operator *shall* have a stabilized approach policy with associated guidance, criteria and procedures to ensure the conduct of stabilized approaches. Such policy *shall* specify:
(i) A minimum height for stabilization not less than 1000 feet AAL for approaches in IMC or not less than 500 ft. AAL for approaches in IMC as designated by the operator and/or State where a lower stabilization height is operationally required;

ICAO Doc. 8168 Procedures for Air Navigation Services — Aircraft Operations (PANS OPS) VOL I (Flight Procedures) states that the elements of a stabilised approach **should** include as a minimum that all flights of any nature shall be stabilised by no lower than 500 feet height above threshold. The IATA Standards Manual, on the other hand states that the stabilization policy **shall** specify a minimum height for stabilization not less than 500 feet aal for approaches in IMC.

- The IOSA Parallel Conformity Option (PCO) exists in IOSA to allow for alternate means of compliance for operators who cannot meet a Standard due to certain circumstances, as pre-identified
- Nothing in IOSA generally allows for an alternate means of compliance to *enhance* safety, e.g. where a Standard may be underperforming (obsolete, ineffective, or outdated), which is a flaw

Recommendation

Broaden the use of a PCO where reasoned by an operator's SMS, which would allow a means for operators to comply with IATA Standards Manual ORG 3.1.2 to establish new and better practices for even prescriptive Standards and for IOSA to evolve.

17 LITHIUM BATTERY FIRE

The presenting airline showed two recent cases involving near miss-Lithium Battery Fires on the ground.

Near-miss No.1

The airline's cargo department in VHHH accepted a shipment declared as "Baby Wear" and a "Baby Toy Car" as well as "Lithium Batteries packed with equipment". The regular Agent, who had accepted the shipment from a known Consignor, handled the shipment.

Shortly after being offloaded at the airline's home base, a pallet containing part of the shipment began to smoke and within a few minutes a box at the bottom of the pallet exploded less than 50 metres away from the aircraft.

The shipment included 103 packages with 1000 – 2000 standalone lithium batteries & power banks

The IATA limit is 2 standalone lithium batteries per package.

Lessons Learned / Comments

- All documentation was in order with the packages appropriately labelled
- Per the local security requirements, the shipment was not required to be screened and did not fall into the random screening pool
- The fraudulent declaration was not detected at acceptance
- The flight was ahead of schedule by 20 minutes due to tail winds. Had it been on time, the explosion would have happened in-flight

Near-miss No.2
The airline accepted a shipment declared as "Laptops" as the nature of goods. When preparing the container with the shipment, the Ground Handling Agent (GHA) Staff dropped it approximately 30 centimetres on to the ramp and manipulated it repeatedly with several shocks applied to the container.
It began to smoke four minutes later.

After 11 minutes the container and contents were fully engulfed in flames.

Lessons Learned / Comments

- The shipment contained laptops packed in file boxes available from office supply stores
- All documentation was in order with the packages appropriately labelled
- The commodity was accurately declared but the packing requirements and screening requirements failed to detect the damaged laptops
- Turbulence experienced on the flight where the shipment should have been loaded could have created the same shocks as applied by the GHA Staff

An FAA document has recorded 258 air/airport incidents from 1991 including more than 20 events in the last two years involving cargo in which Lithium batteries were involved.

Prevention Strategies – What the industry needs to do

Promote

- Engage task forces to drive industry change
- Develop an awareness campaign for regulators and consumers

Protect

- Develop more stringent Lithium Battery packaging requirements
- Expand cargo screening to encompass safety as well as security risks

Learn

- Develop a global database on Lithium Battery carriage and events
- Drive compliance and accountability within the supply chain

Mitigate

- Develop fire containment solution standards
- Support development of fire suppression technology for future aircraft orders

Recommended Actions

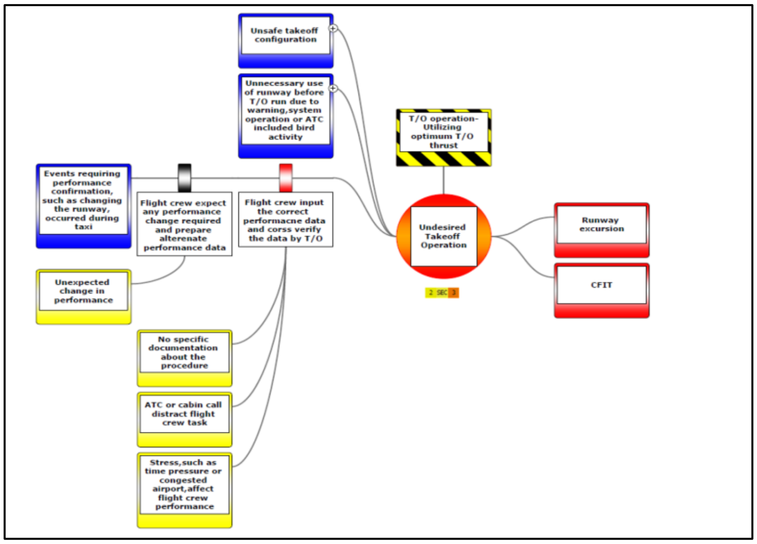
- Emphasize the lithium battery fire risk within your cargo, ground operations, flight operations, safety, security, and industry affairs groups
- Emphasize the need for stronger regulatory intervention with your civil aviation authority

18 TAKE-OFF PERFORMANCE CHANGES DURING TAXI

An air carrier identified a runway event, which saw an aircraft utilize the take-off performance data for RWY 10L when the actual take-off was from RWY 01L.

Another event took place at Narita International airport (RJAA) where an airline took off from RWY 16L with the take-off performance data for RWY 16R. This event was classified as serious Incident.

The presenting airline analysed both events and has come up with a solution on how to handle performance-related changes occurring during taxi. In both events, the runway changes should have led to a re-calculation of the take-off performance data.



Preventive defences

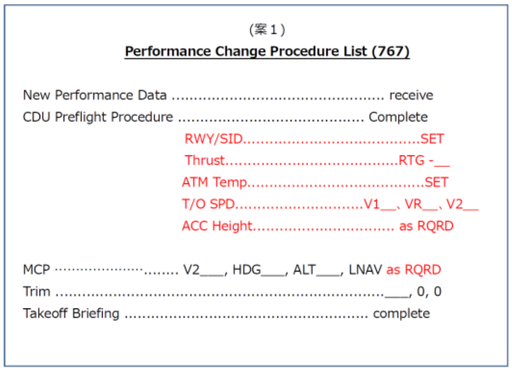
The undesired take-off operation could have been prevented if the flight crews had anticipated and prepared data for possible runway changes prior to taxi or stopped taxiing to re-calculate the take-off performance and made a verification of the entered data.

Recovery defences

No specific barriers exist to detect the low thrust condition.

End State

- CFIT
- Runway Excursion



(案 1)

Performance Change Procedure List (767)

New Performance Data .... receive
CDU Preflight Procedure .... Complete
RWY/SID.......................................SET
Thrust.....................................RTG -__
ATM Temp.......................................SET
T/O SPD............................V1__、VR__、V2__
ACC Height.............................. as RQRD

MCP .... V2___, HDG___, ALT___, LNAV as RQRD
Trim ....___, 0, 0
Takeoff Briefing .... complete

As a safety enhancement the presenting airline has re-written their SOP to include a Performance Change Procedure Checklist, which must be used when take-off parameters change during taxi.

Lessons Learned / Comments

- Monitor FDM for late rotation to capture the insufficient Take-off Performance
- Assumed Temperature Methodology or Optimum V1, Improved Climb are there to improve engine life cycles, but it is essential to know the risks behind low take-off thrust

IRM 27 survey results – summary

We would like to thank everyone who took the time to give their feedback in the IRM 27 survey – over 60% of participants shared their thoughts and opinions.

The overall message is clear: participants appreciated this year's format and would like to continue keeping a good balance between discussing emerging and current issues faced by the industry, as well as between real-life incident reviews and academic presentations.

Irrespective of the topic, respondents highlighted their appreciation for presentations with practical application: what were the safety hazards identified? what can we learn from the incidents and do differently in the future to prevent these safety issues from happening again and/or to minimize related risks?

Respondents also asked to avoid commercially-focused presentations and keep the focus on better understanding and further improving safety.

Other areas that participants frequently brought up included

- Safety II
- Human Factors
- Risk management, including fatigue risk management
- Safety data and information – how to extract the most value from the data and information gathered
- Follow-ups / updates on past presentations, as applicable

Thank you again for your participation.

NEXT IRM MEETING

The next IRM meeting – IRM 28 – will be held on **March 10-11, 2020**.
The meeting will take place in **Dallas** (Texas, USA) and will be hosted by American Airlines.

MARCH 2020						
SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10 IRM 28	11 IRM 28	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

To register via the IRM SharePoint website you will first need to sign up here for access to the site (https://extranet.iata.org/Registration/pages/GetEmailPage.aspx?siteUrl=hitf).

This is a one-time registration and will provide you on-going access to the IRM Share Point site. You will receive confirmation within 48 hours, which will allow you to sign into the IRM SharePoint website https://corp-extranet.iata.org/sites/hitf/default.aspx.

This is where you can access meeting information and self-register for upcoming meetings.

For more information on the IRM, please contact the IRM team at irm-safety@iata.org.