

Hamburg Aerospace Lecture Series
Hamburger Luft- und Raumfahrtvorträge

HAW Hamburg in cooperation with DGLR, RAeS, ZAL and VDI invites you to a lecture

Current Trends in Commercial Aviation Safety

Dipl.-Journ. **Andreas Spaeth**, Aviation Journalist

Lecture
followed by discussion
No registration required !
Entry free !

Date: Thursday, 01.06.2017, 18:00 Uhr

Location: HAW Hamburg

Berliner Tor 5 (Neubau)
Hörsaal 01.12



Why are pilots flying their perfectly functioning high tech aircraft into the ground once and again? The catastrophes of Air France 447 or Asiana 214 are just two major examples of such human performance deficiencies. How can it be achieved that pilots are brought to the same level as their technically almost accident-resistant aircraft? And on the contrary, how can only humans as pilots find a way out of seemingly inevitable disasters like US 1549, the famous ditching in the Hudson River, or QF 32, the near-death of over 500 people on board an Airbus A380 which could be averted by a highly qualified crew?

Andreas Spaeth is an aviation journalist, book author, and TV expert. He points out recent trends in aviation safety and looks at the hidden risks of flying. Aviation safety is a topic which he as an aviation journalist follows since 30 years and recently published his book "Crashtest" (in German).



Picture copyright Aviation Safety Council, Taiwan.

TransAsia Airways Flight GE235, ATR72-212A,
04.02.2015.
Loss of control and crash into Keelung River.

https://www.asc.gov.tw/upload/acd_att/ASC-AOR-16-06-001%20EN.pdf

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Die **Hamburg Aerospace Lecture Series** (<http://hav-connect.aero/Group/Lectures>) wird gemeinsam veranstaltet von DGLR, RAeS, ZAL, VDI und HAW Hamburg (Praxis-Seminar Luftfahrt, PSL). Der Besuch der **Veranstaltung ist steuerlich absetzbar**. Bringen Sie dazu bitte eine ausgefüllte Teilnahmebestätigung zur Unterschrift zum Vortrag mit. Mittels **E-Mail-Verteilerliste** wird über aktuelle Veranstaltungen informiert. **Vortragsunterlagen** vergangener Veranstaltungen, aktuelles **Vortragsprogramm**, Eintrag in E-Mail-Verteilerliste, Vordrucke der Teilnahmebestätigung: Alle Services über das Internet: <http://hamburg.dglr.de> .

Current Trends in Commercial Aviation Safety

Dipl.-Journ. Andreas Spaeth, Aviation Journalist

Twitter @SpaethFlies

Hamburg Aerospace Lecture Series

June 1, 2017

About the Lecturer

- Andreas Spaeth, born 1966 in Hamburg
- Follows commercial aviation safety since the 1980s, started career as aviation journalist in 1988, alumnee of Deutsche Journalistenschule (DJS) and Ludwig-Maximilian-University in Munich, works for German and international media (print, online, TV, radio), book author (Concorde, A380), lecturer.
- Travelled as passenger on most passenger airliner types existing, including 9 times on Concorde, has visited airlines and airports in 109 countries worldwide.



Question

- About 3.7 billion passengers travelled by air in 2016.
- How many fatalities did commercial airline flights suffer in 2016?

Answer

- 175

March 19	flydubai	Boeing 737	Rostov	62 fatalities
May 19	Egypt Air	A320	Mediterranean	66 fatalities (Sabotage?)
December 12	PIA	ATR-42	Pakistan	47 fatalities

- Not counting November 28 LaMia Avro RJ85 La Paz 71 fatalities, charter
- In 2015, this number was even lower, only 107 fatalities on regular airline passenger flights worldwide, not counting Germanwings crash and Metro Jet bombing.

Flying is a very safe mode of transport

- Flying was never as safe as today, while never before as many people flew
- Since 2006 the number of fatalities is constantly lower than 1,000
- Every day 9 million passengers worldwide, half a million in the air at any time
- Comparing to road traffic (pedestrians and cars, 2010, source WHO):
- 1,24 million fatalities globally, one victim every 25 seconds, India alone had 238,562 traffic victims, Germany had 3,214 road traffic victims in 2016

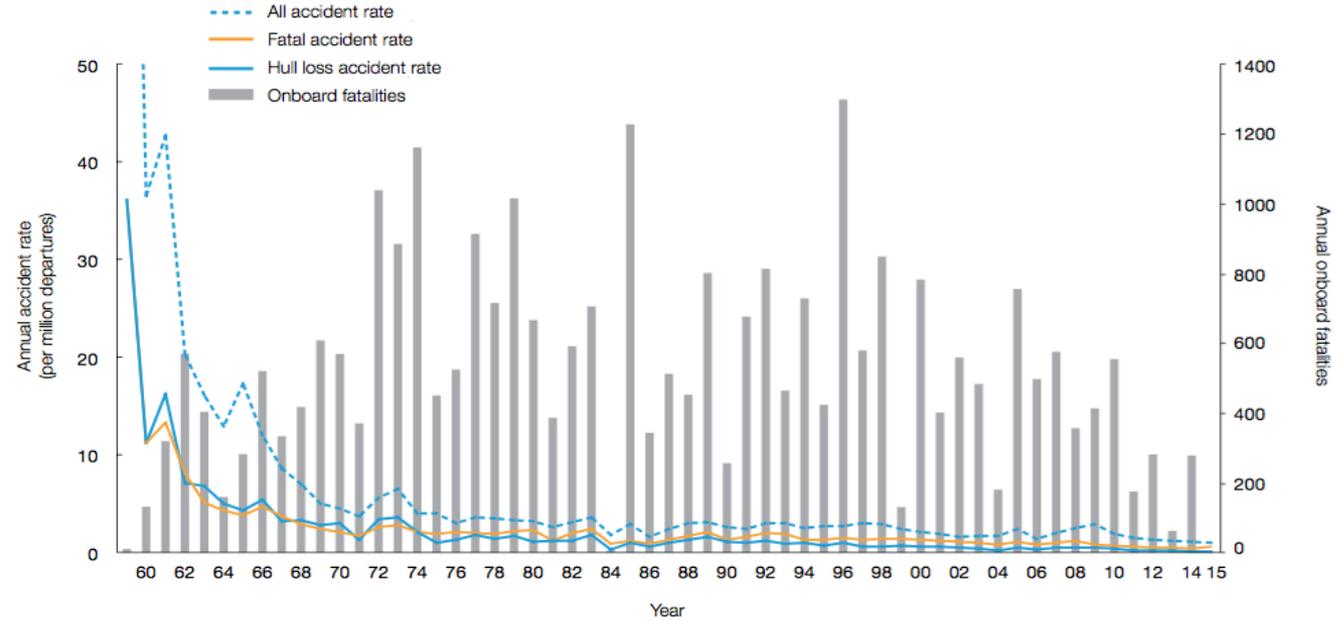
Extreme improvement

- Probability to die by lightning in Europe: **1: 10,500,000**
- Probability to die in an air crash (Europe/USA): **1: 29,000,000**
- One fatality in commercial aviation every 5.7 million flights
- Extreme improvement vs. 1970s: **One fatality every 670,000 flights** in a Western-built passenger jet
- Had the 1950s safety standards prevailed at current passenger volumes, there would be ten deadly crashes daily with 50,000-200,000 fatalities p. a.

Accident Rates and Onboard Fatalities

Accident Rates and Onboard Fatalities by Year

Worldwide Commercial Jet Fleet | 1959 through 2015



Worldwide Numbers

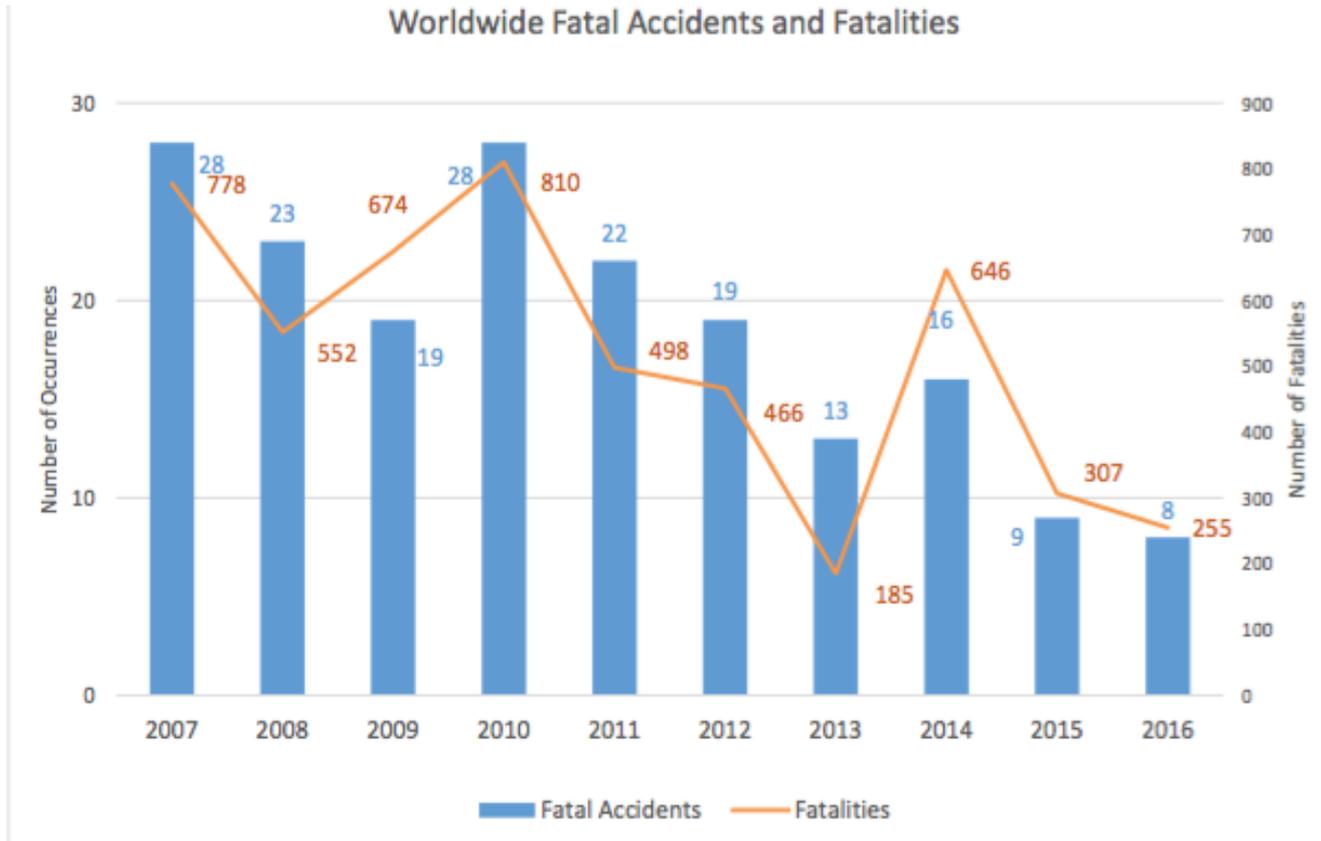
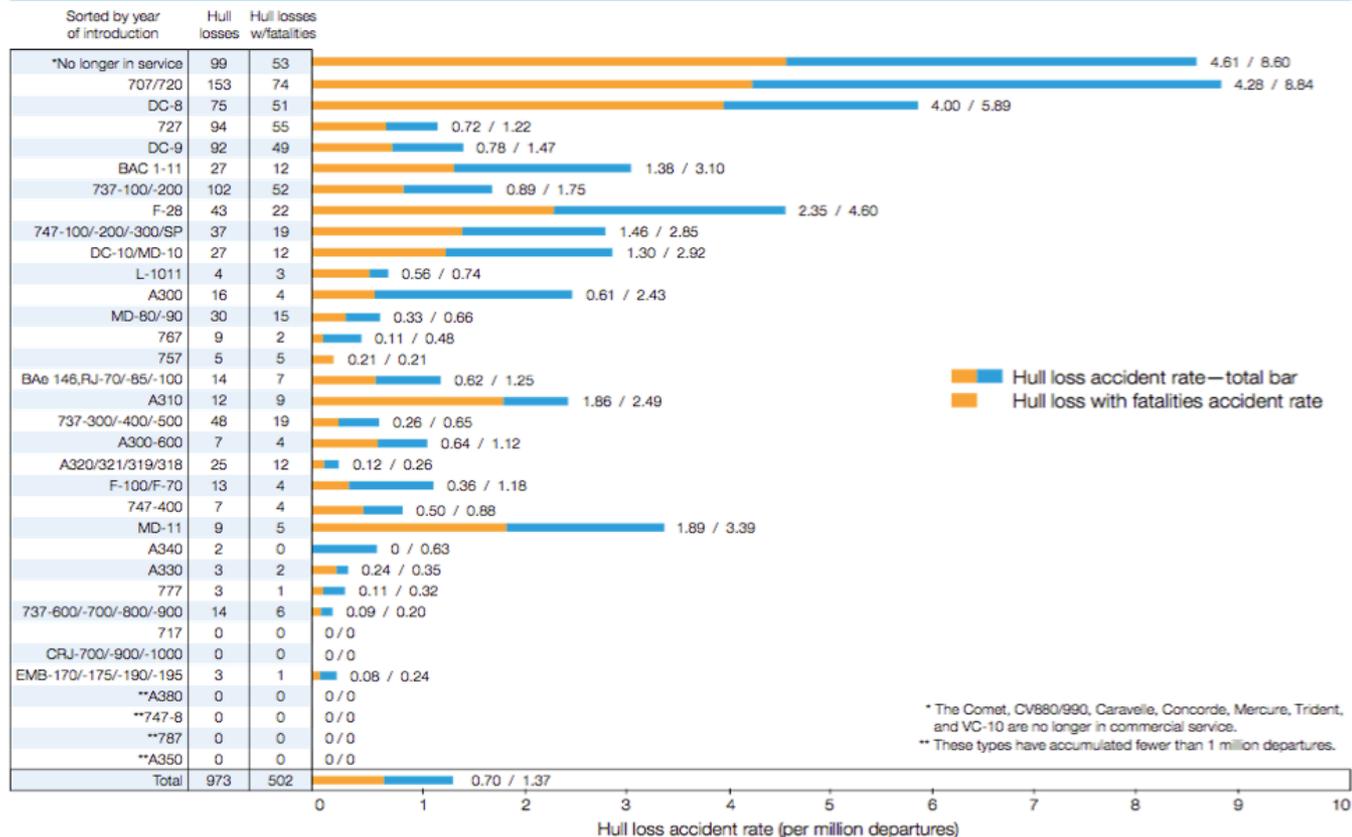


Figure 1 - Worldwide Fatal Accidents and Fatalities - 2007 to 2016.

Rates by Airplane Type

Accident Rates by Airplane Type

Hull Loss Accidents | Worldwide Commercial Jet Fleet | 1959 through 2015

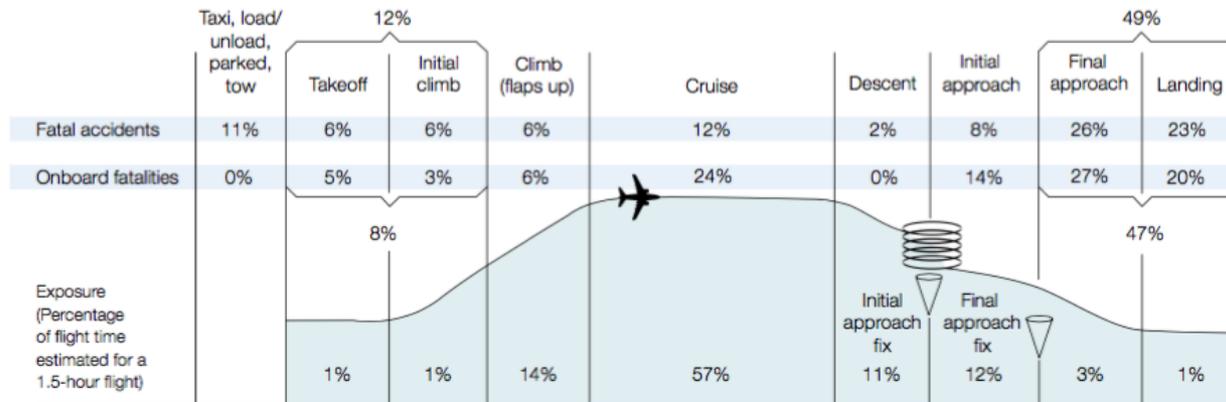


Phase of Flight

Fatal Accidents and Onboard Fatalities by Phase of Flight

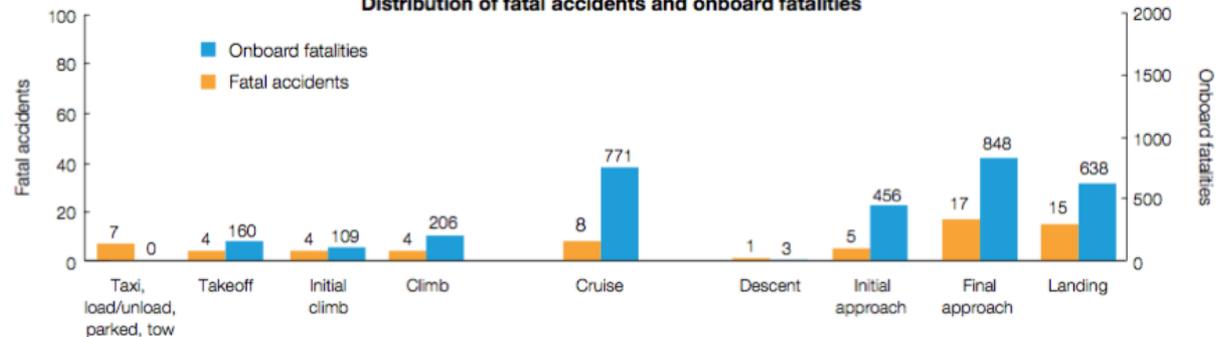
Fatal Accidents | Worldwide Commercial Jet Fleet | 2006 through 2015

Percentage of fatal accidents and onboard fatalities



Note: Percentages may not sum to 100% due to numerical rounding.

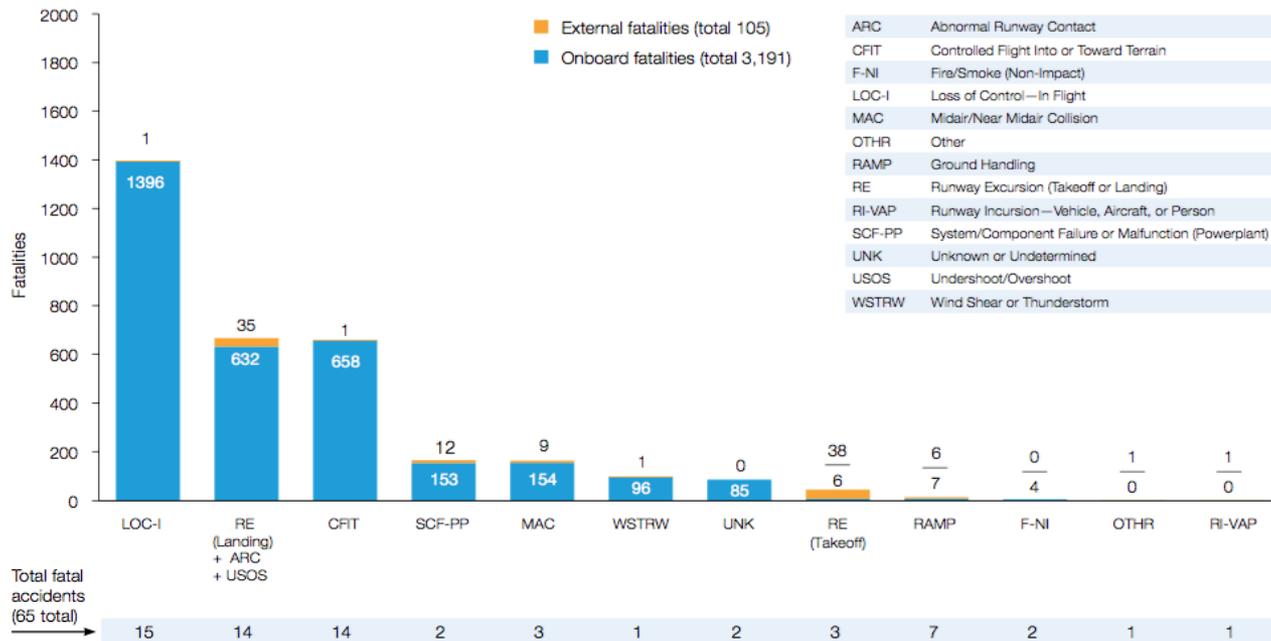
Distribution of fatal accidents and onboard fatalities



Main driver of hugely improved aviation safety is technological progress.
 Main weakness can be the human factor.

Fatalities by CICTT Aviation Occurrence Categories

Fatal Accidents | Worldwide Commercial Jet Fleet | 2006 through 2015



Note: Principal categories as assigned by CAST.

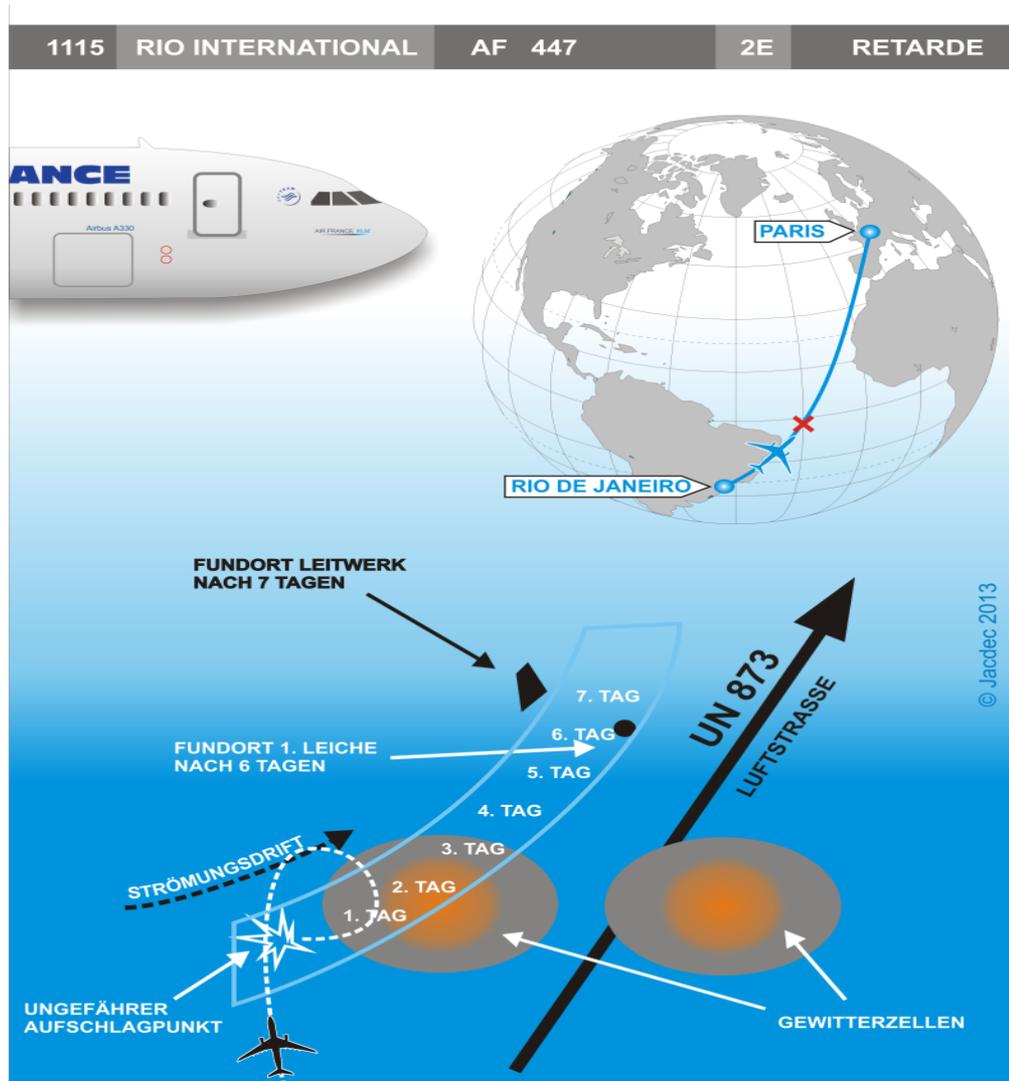
For a complete description of CAST/ICAO Common Taxonomy Team (CICTT) Aviation Occurrence Categories, go to www.intlaviationstandards.org.

Human performance as a risk

- While technology is more reliable than ever, human performance often lacks to keep track.
- Today's pilots have often never trained basics of aeronautics and mostly learnt how to fly on computers and simulators, with no practical training of aircraft recovery.
- Serious deficiencies in handling abnormal situations in the cockpit have led to several major crashes in recent years.
- Examples: Air France 447 in 2009, Asiana 214 in 2013, TransAsia 235 in 2015.

AF447 Airbus A330 from Rio to Paris, June 1, 2009

228 people on board



AF447 – an unnecessary and avoidable catastrophe

- After take off, pilot retires, leaving cockpit to two young first officers (less than 3,000/6547 flight hours), despite worsening weather.
- Pilot does not formally delegate duties to more senior pilot to replace him
- F/O wants to climb to 36,000 ft to get over solid thunderstorm front
- Unknown to pilots, pitot tubes ice over in heavy weather, leading to contradictory speed indications and to autopilot turnoff, meaning aircraft flies under Alternate Law
- still there is no actual problem, just continue normal flight would have been the right thing

AF447 is doomed due to pilots lacking basic skills

- but pilots don't understand their aircraft, get into panic mode and execute contradictory, extreme manoeuvres
- total lack of Cockpit Resource Management
- returning captain lacks leadership and analytical abilities
- within four minutes and 23 seconds the aircraft plunges from normal flight at 35,000 feet to the ocean surface and crashes

Only on April 3, 2011, almost two years after the crash, the main wreckage of AF447 is located on the ocean floor, including the CVR and FDR

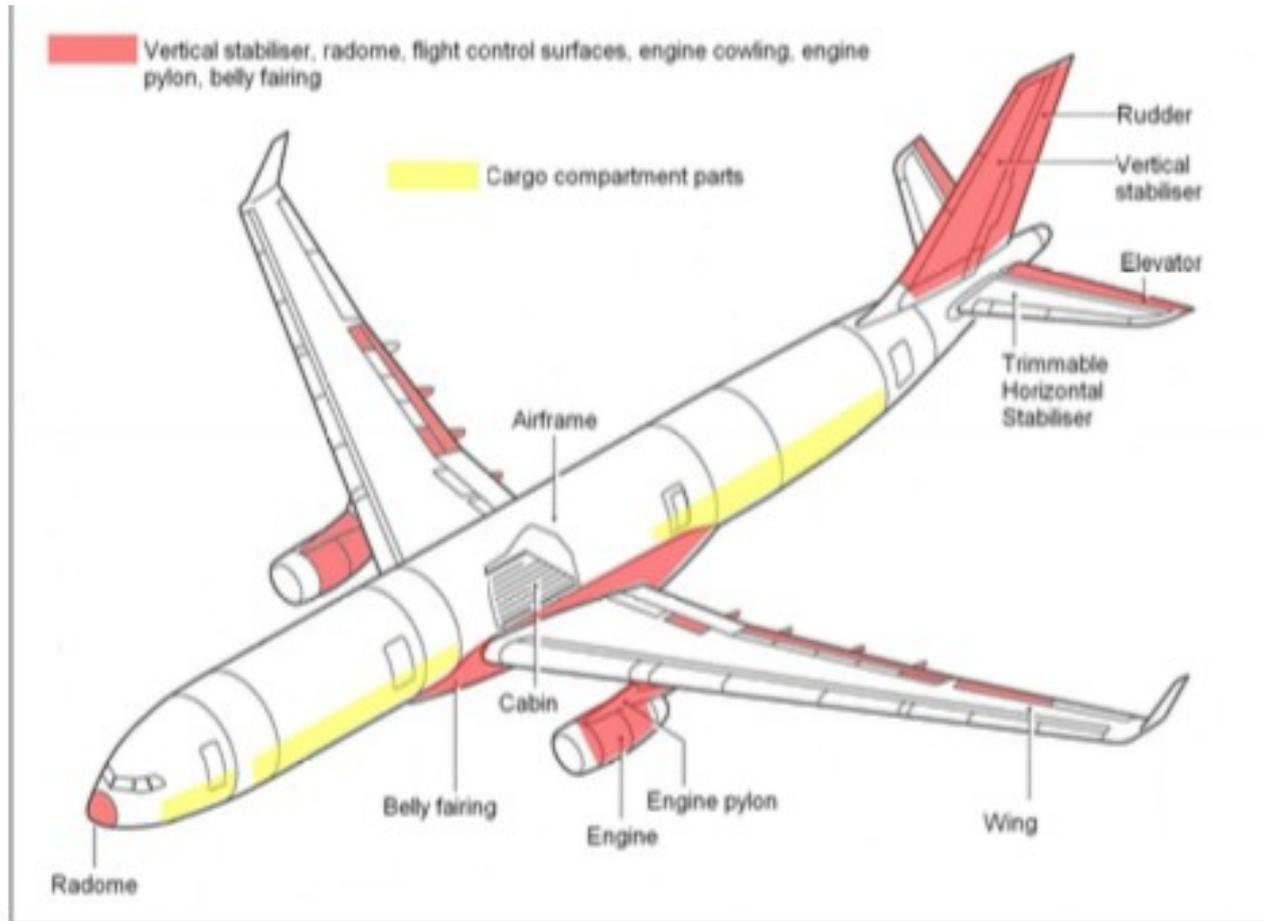
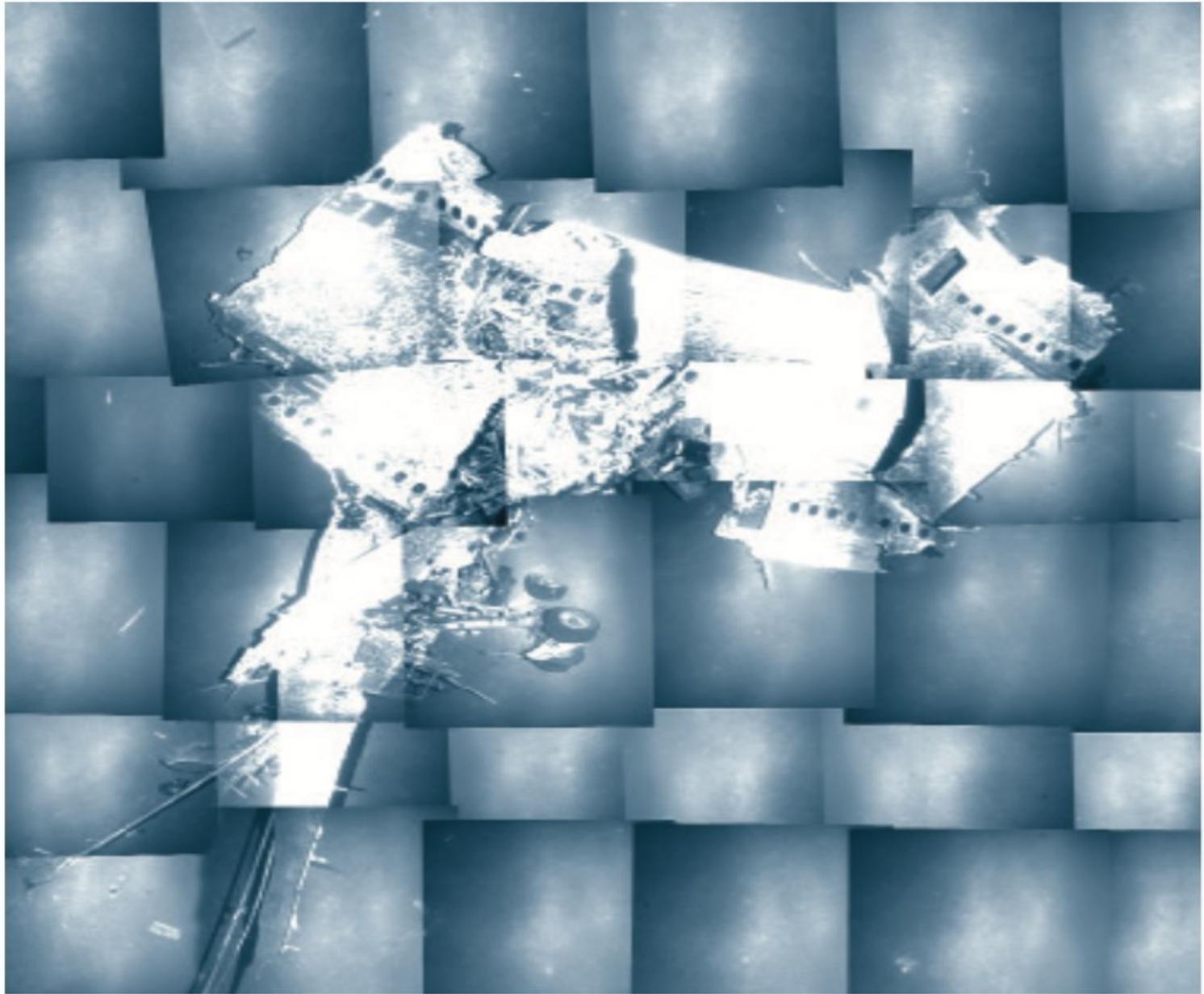


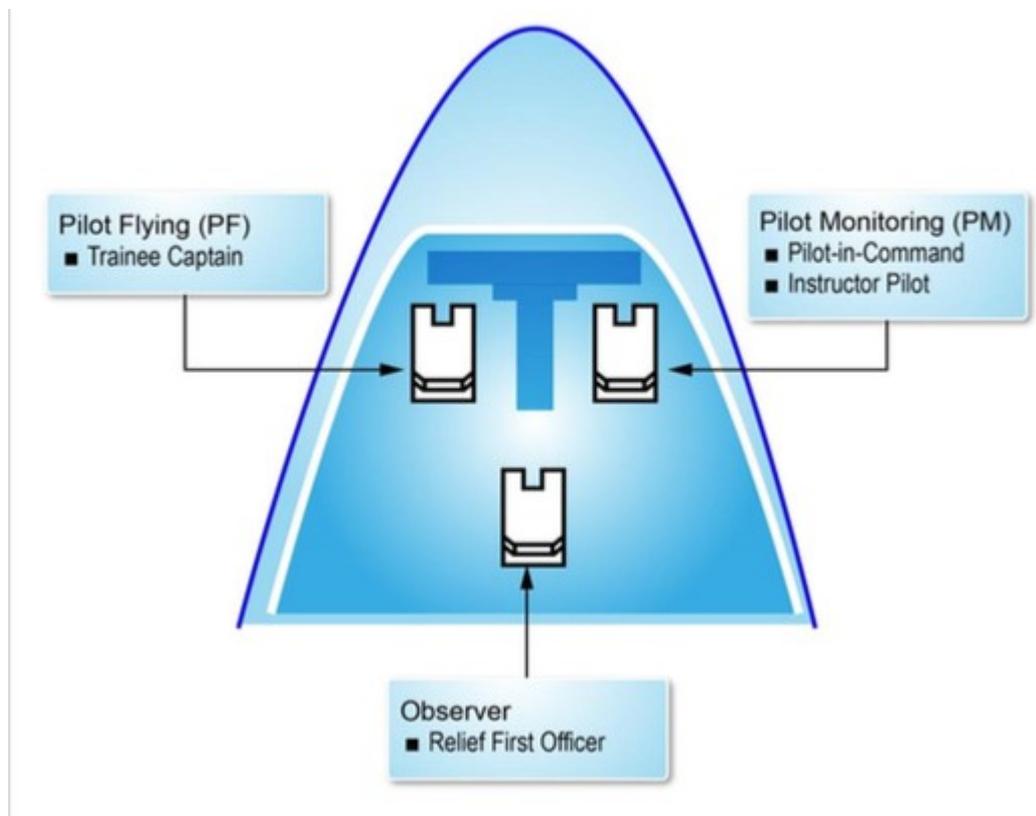
Figure 33: Position of the recovered parts (exterior and cargo)



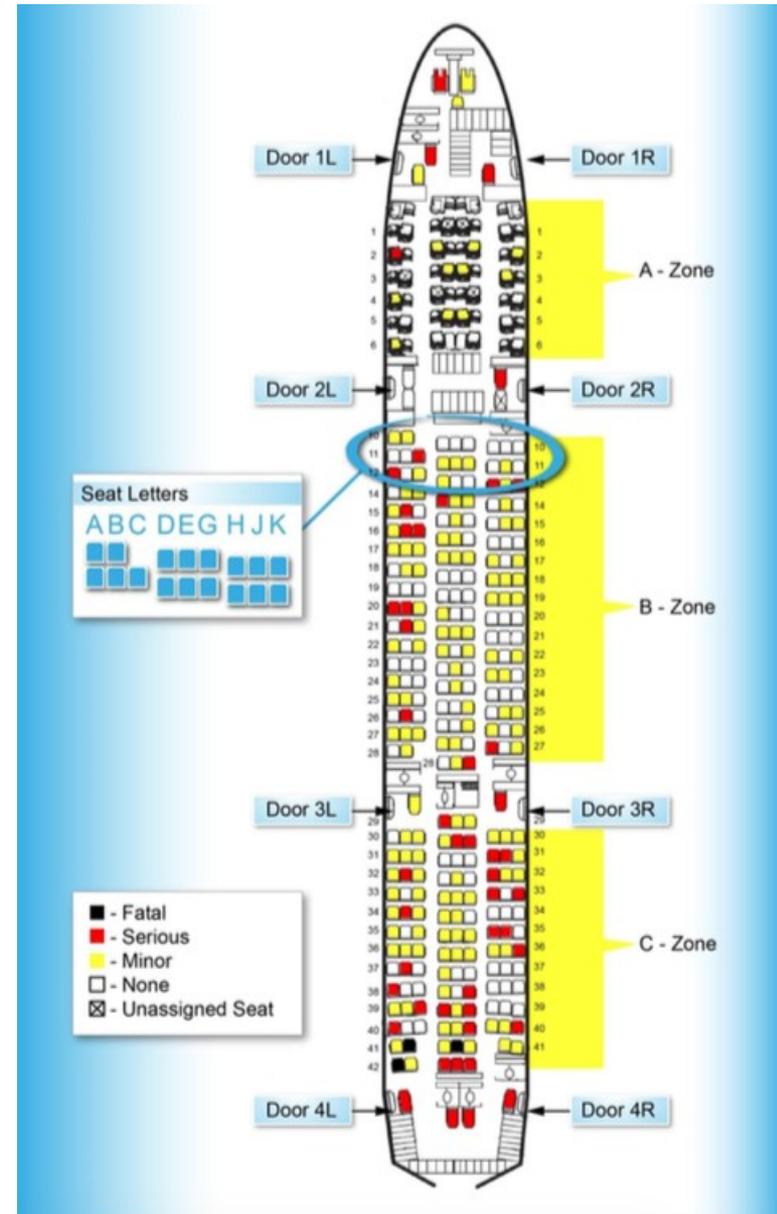
Asiana flight OZ214 from Seoul to San Francisco

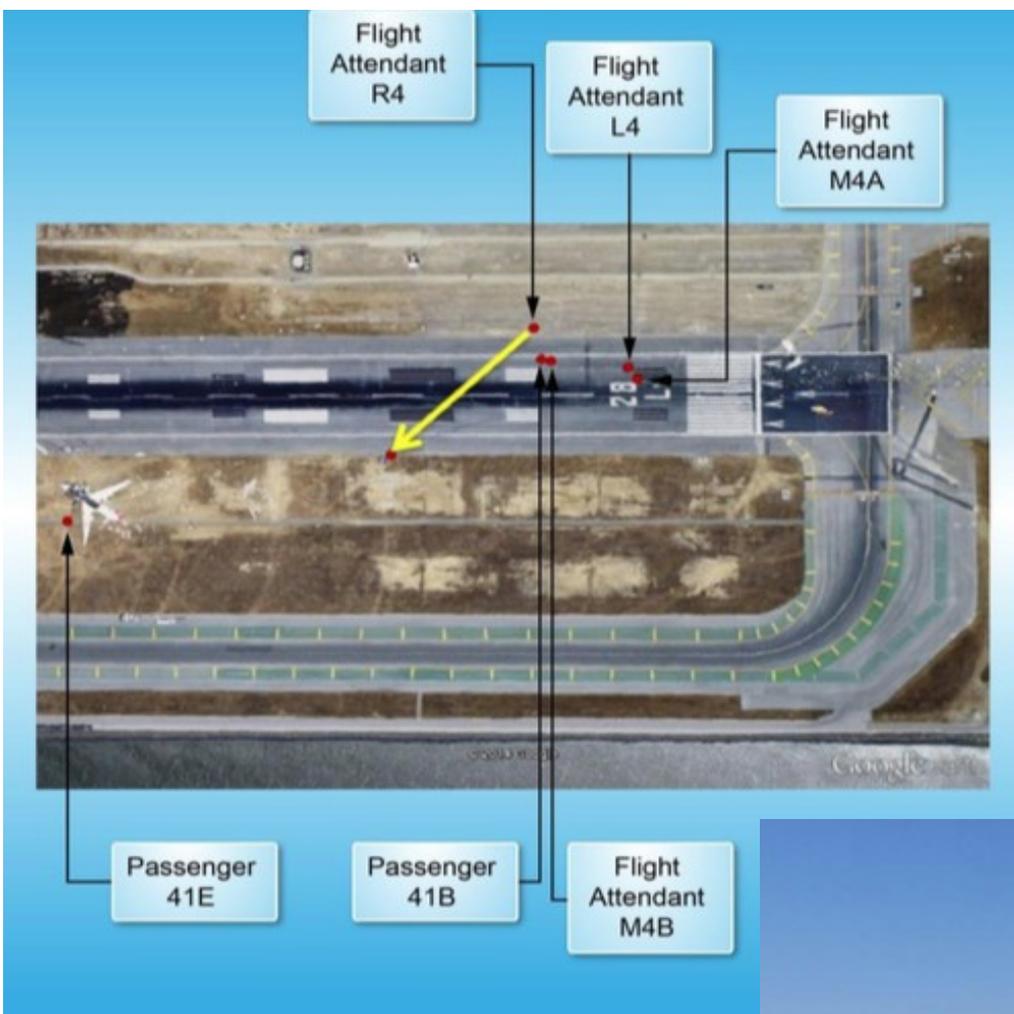


- Perfect clear summer day in San Francisco
- Approach is flown by hand as ILS is inoperative



- Two experienced pilots, but trainee on left seat has only 43 of 9,739 hours on 777, it's his first 777 landing in SFO
- For PIC on right seat it's his first flight as instructor
- Approach is too low, but crew only realizes at 200 feet that it is also too slow, but the immediate decision to go around is not taken
- Aircraft crashes onto the seawall of the runway, cartwheels and partially burns
- Three passengers die, 49 are seriously injured, but most of 307 occupants escape unharmed and are able to free themselves





Asiana flight OZ214 from Seoul to San Francisco

- Low number of casualties remarkable proof of how safe and robust modern aircraft are built, with a huge safety margin
- Accident cause is catastrophic failure of Cockpit Resource management and “mismanagement of the approach by the crew”
- Korean pilot culture of hierarchical thinking played significant role
- Relying on Auto Throttle and unawareness that it was in silent mode was main cause
- NTSB recommends “more manual flying”

Trans Asia flight GE235 from Taipei to Quemoy, February 4, 2015 -ATR72 with 58 people on board



Figure 1.1-1 GE235 lost control and first impact picture

Trans Asia flight GE235 from Taipei to Quemoy

February 4, 2015

ATR72 with 58 people on board

- 37 seconds after take off failure of **right** engine
- Pilot reacts wrong and reduces thrust of remaining **left** engine to idle
- while aircraft is gliding powerless, one pilot pushes thrust lever for failed **right** engine forward
- Too late they realize their mistake and give thrust back to functioning engine
- two minutes and 40 seconds after rotation aircraft crashes upside into Keelung River
- 39 passengers and four crewmembers die, 13 are severely injured
- This was fifth crash for TransAsia since 1995, airline ultimately shuts down

BUT: When Technology fails, GOOD Pilots can make a difference

Qantas flight QF32, Airbus A380, Singapore to Sydney, November 4, 2010



QF32 – catastrophe averted

- first-ever Qantas Airbus A380, total 469 people on board
- four minutes after take-off two explosions rock the aircraft at 7,400 feet
- hugely experienced flight crew (3 pilots plus 2 check pilots, 71,000 hours altogether)
- including a combined 5,000 hours on the A380 already
- PIC Richard de Crespigny has 15,140 hours at that time

Figure 12: Property damage from a section of the No. 2 engine turbine disc



Image source: Courtesy of the 'Posmetro' newspaper, Indonesia.

QF32: Learning to fly a crippled aircraft

- number two engine has suffered from an uncontained failure, turbine disk has failed and hit houses in Bata, Indonesia
- pilots follow basic rule for emergency: Fly, Navigate, Communicate
- they have to learn about the abilities remaining to fly their crippled aircraft
- potentially biggest catastrophe in civil aviation history
- very difficult to manoeuvre the aircraft and to communicate
- wings, vital links and fuselage have been hit by about 150 shrapnel-like pieces from disintegrating engine
- out of 22 vital aircraft systems, 21 have been damaged on board QF32

Figure 3: Fuel leaking from the left wing

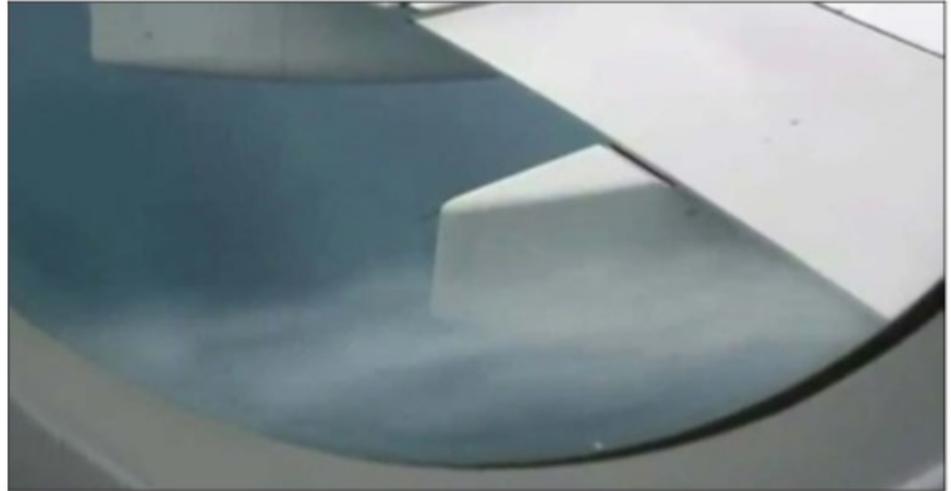


Image source: Supplied by a passenger.

Figure 7: Examples of damage to the left wing



Image source: Supplied by a passenger.

QF32 – a happy landing, but then the ordeal drags on

- one hour and 49 minutes after take-off, the heavily damaged A380 can be landed back at Singapore, a major crew achievement
- on landing, four tires burst and brakes got red hot, while fuel is leaking from holes in wings
- no more electrical power on board, but number one engine can't be cut, fire engine has to stop it with foam
- only one hour after landing passengers can disembark

Figure 4: Fire-fighters 'drowning' the No. 1 engine with foam



Image source: Supplied by the Air Accident Investigation Bureau (AAIB) of Singapore.

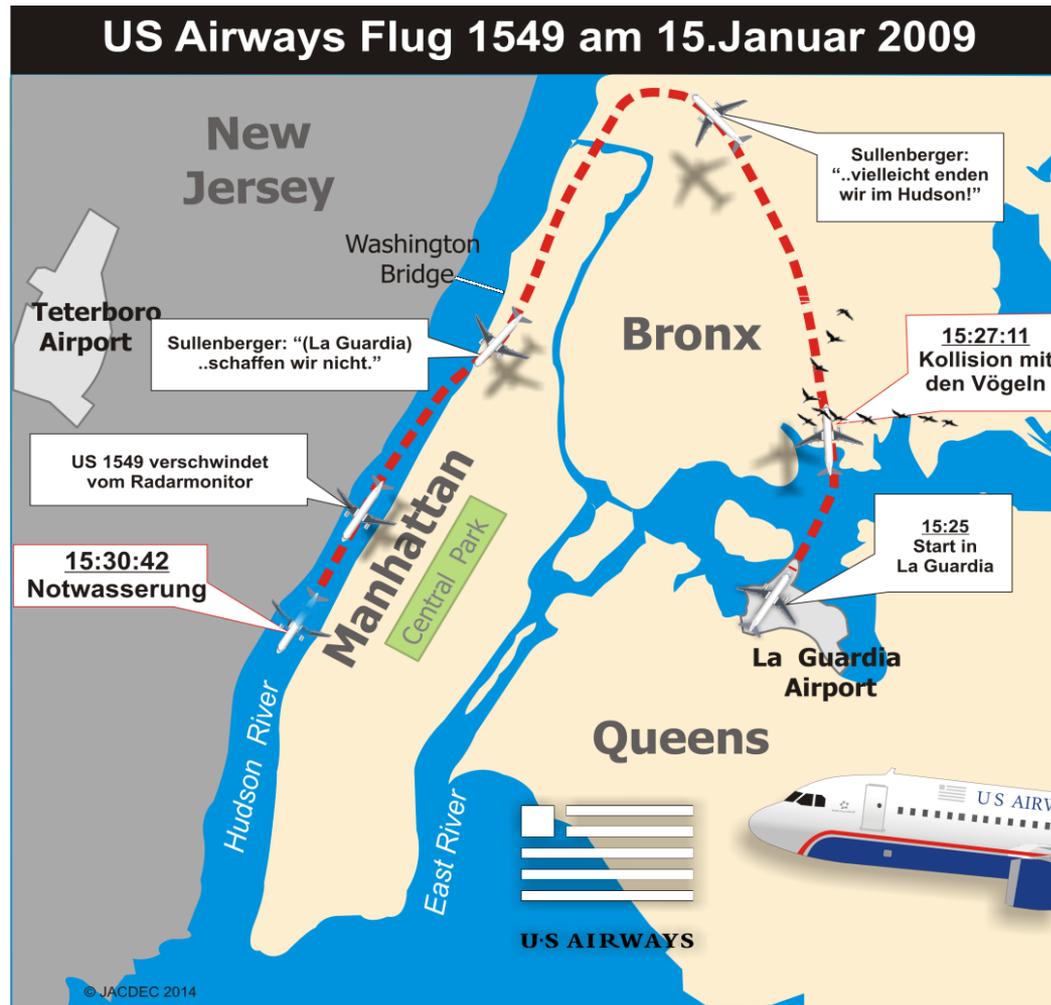
QF32: Extreme damage due to turbine disk failure

- Huge damage to Qantas A380 results in most expensive aircraft repair ever, costing US\$145m and taking one and a half years
- perfect example of how a qualified crew capable to think out of the box can make a difference to any computer system
- without the brilliant brains of humans QF32 would have ended in the worst air disaster of a single aircraft *EVER*

Figure 16: No. 2 engine showing fire damage to the lower left engine nacelle



Another perfect example for brilliant airmanship is of course US1549, the famous Hudson River landing of an Airbus A320 after double engine failure on January 15, 2009



Brilliantly executed ditching on the Hudson river, with the pilots instinctively doing the right thing, proving again that real airmanship of experienced aviators can't be replaced by computers



New threat to aviation safety from Lithium Ion batteries

- EASA estimates every passenger carries up to five battery-powered gadgets, each one posing a potential safety threat



Andreas Spaeth @SpaethFlies · 15. März

Passenger's li-ion battery operated headphones explode in flight and burning her, underscoring danger airlineratings.com/news/1098/head...

pic.twitter.com/iwNksVbFdh

FAA updates list of incidents regularly, states 152 cases in 26 years in US alone, only tip of the iceberg

LITHIUM BATTERIES & LITHIUM BATTERY-POWERED DEVICES

Aviation Cargo and Passenger Baggage Events Involving Smoke, Fire, Extreme Heat or Explosion Involving Lithium Batteries or Unknown Battery Types

In an effort to more closely focus on lithium battery events, this list has been revised to include events involving lithium or unknown battery types.

As of March 27, 2017, 152 air/airport incidents involving lithium batteries carried as cargo or baggage that have been recorded since March 20, 1991

Date	Source	Type of Battery	Device (if applicable)	Carrier	Aircraft Type (Passenger or Cargo)	Incident Summary
2/19/2017	Media	Li-ion	Noise Cancelling Headphones	Air China	Passenger	An Air China Airbus A330-200 (flight 165) on a flight from Beijing (China) to Melbourne,VI (Australia), was approximately 2 hours into the flight when the noise cancelling headphones of a sleeping passenger started to overheat. The passenger was awakened by the heat of the headphones on her face. The headphones slid down around her neck and caused minor burns to her face and neck. The headphones were getting hotter and when they began sparkling and melting, she threw the headphones onto the cabin floor. Cabin crew poured water over the headset cooling the device down. The headset was subsequently put into a safe container. The aircraft continued the flight to Melbourne for a safe landing approximately 10 hours later.
2/18/2017	Media	Li-ion	Cell phone and battery pack	Spring Airlines	Passenger	A Spring Airlines Airbus A320-200, flight 9C-8617 from Harbin (China) to Nagoya (Japan), was enroute at FL340 about 50nm east/northeast of Shenyang (China) when passengers observed a fire in one of the overhead bins. Cabin crew discharged fire extinguishers into the overhead bin and submerged a passenger's charger (power bank) and smartphone, which had caught fire, into a water container. The flight crew initiated a diversion into Shenyang, where the aircraft landed safely about 23 minutes later. Emergency services were not called as the cabin crew had brought the situation fully under control by cooling down the charger/batteries.
2/4/2017	Carrier	Li-ion	Cell phones	American Airlines	Passenger	American Airlines Ground crew at Dallas Fort Worth, TX noticed smoke coming from a freight cart. DFW Fire Rescue called and extinguished the fire. US Postal Inspectors are investigating as it was contained in US Mail. Item has been reported as a Samsung phone (not confirmed, unknown model or version). No damage to the aircraft or injuries reported.
1/22/2017	Carrier/TSA	Li-ion	Battery pack / charger (Hyper Gear)	Southwest	Passenger	During flight a passenger gave a lithium-ion battery pack/charger to the flight attendant stating that it was smoking and very hot. The flight attendant submerged the unit in ice water to cool it down. The flight continued without any further incident.

At least three crashes of cargo aircraft have been attributed to fires started by lithium battery cargo shipments:

February 7, 2006	UPS	DC-8	Philadelphia
September 3, 2010	UPS	Boeing 747-400 F	Dubai
July 28, 2011	Asiana	Boeing 747-400 F	Cheju

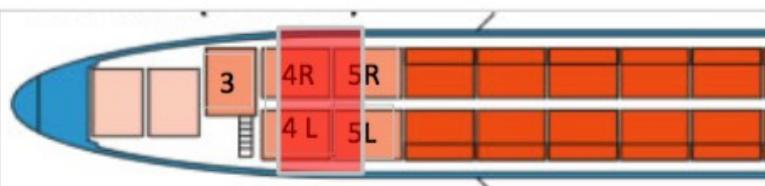


Figure 58 - Pallet Locations/Fire location

Shipments of batteries are highly hazardous and fire-prone, shipment of batteries as cargo on passenger flights has been banned by ICAO



Fire damaged remains of battery pack with a fractured cell



Additional battery pack remains [LH]/D-Cell size lithium primary batteries. Photo shows fire damaged and undamaged batteries [RH]



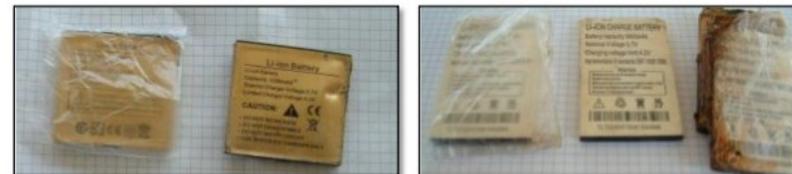
Lithium primary button sized flat cell batteries (watch style) with small circuit board



36-cell lithium-ion battery pack with thermal damage.



36-cell lithium-ion battery pack with multiple vented cells



Lithium-ion, mobile phone type battery

Advice to passengers:

- Carry your gadgets and replacement batteries in your cabin bag
- crews can act on board if a fire is detected during the flight.
- BUT: Current laptop ban in cabins on flights from Middle East threatens safety
- **Wrong-footed aviation security threatens aviation safety**

Cabin ban on larger electronic devices

■ On direct flights to UK ■ On direct flights to US & UK ■ On direct flights to US



Thank you, have a safe flight!

QUESTIONS?

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