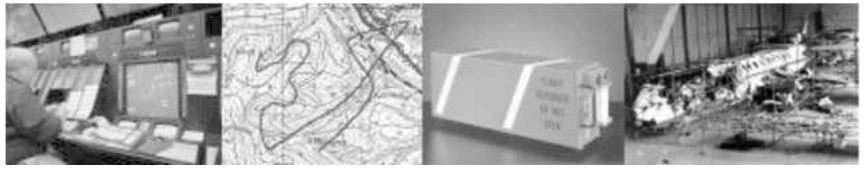
Bundesstelle für
Flugunfalluntersuchung



A stony way
to investigate into incidents

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EASA Workshop - April 11th 2016

A stony way to investigate into incidents

Key Questions:

- How to extract safety issues in a frame of an investigation?
- How to decide when a study has to be started?

How to extract safety issues in a frame of an investigation?

- Get all factual information you can get
- Make an analyses
- Build up the event tree
- Find the causes
- Formulate the safety recommendations

How to extract safety issues in a frame of an investigation?

Building the event tree:

- For all events in the sequent of events
  - Find the type of event and
  - Find the phase of flight
- End For

3 level of an event in the event tree

1. **What** happens (type of event – phase of event
2. **How** it happens (descriptive factor – modifier)
3. **Why** it happens (explanatory factor – modifier)

Building the event tree means:

For each events in the sequent of events clarify

- type of event (what happened) in what phase of flight
  - descriptive factor – modifier (how it happened)
    - explanatory factor – modifier (why it happens)

Next event

- type of event (what happened) in what phase of flight
  - descriptive factor – modifier (how it happened)
    - explanatory factor – modifier (why)

Next event

- type of event (what happened) in what phase of flight
  - descriptive factor – modifier (how it happened)
    - explanatory factor – modifier (why)

Next …

End For

Causes for a specific event

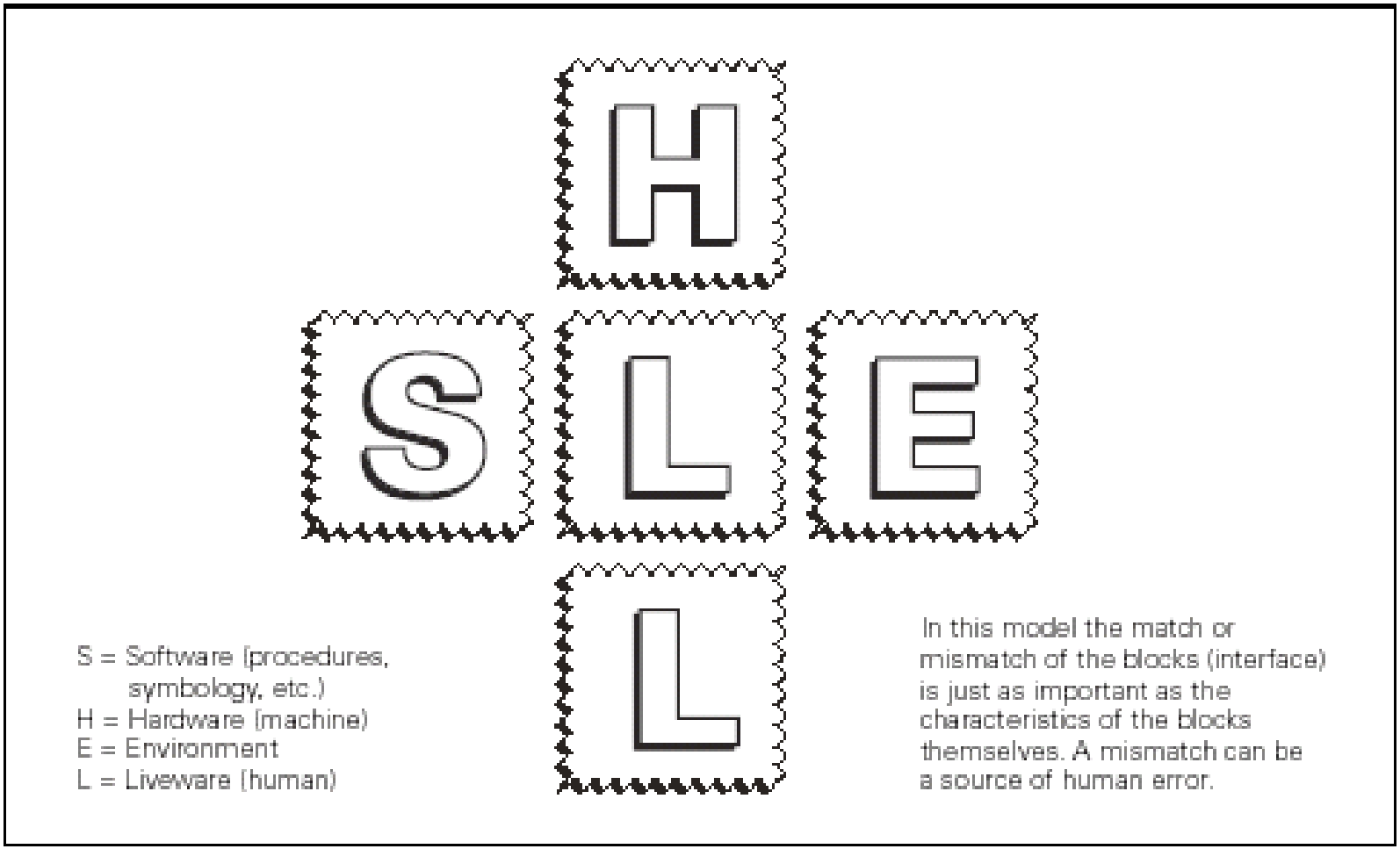
3. **Why** it happens
   (explanatory factor – modifier)

SHELL Modell (implemented in ECCAIRS)

Swiss-cheese Modell

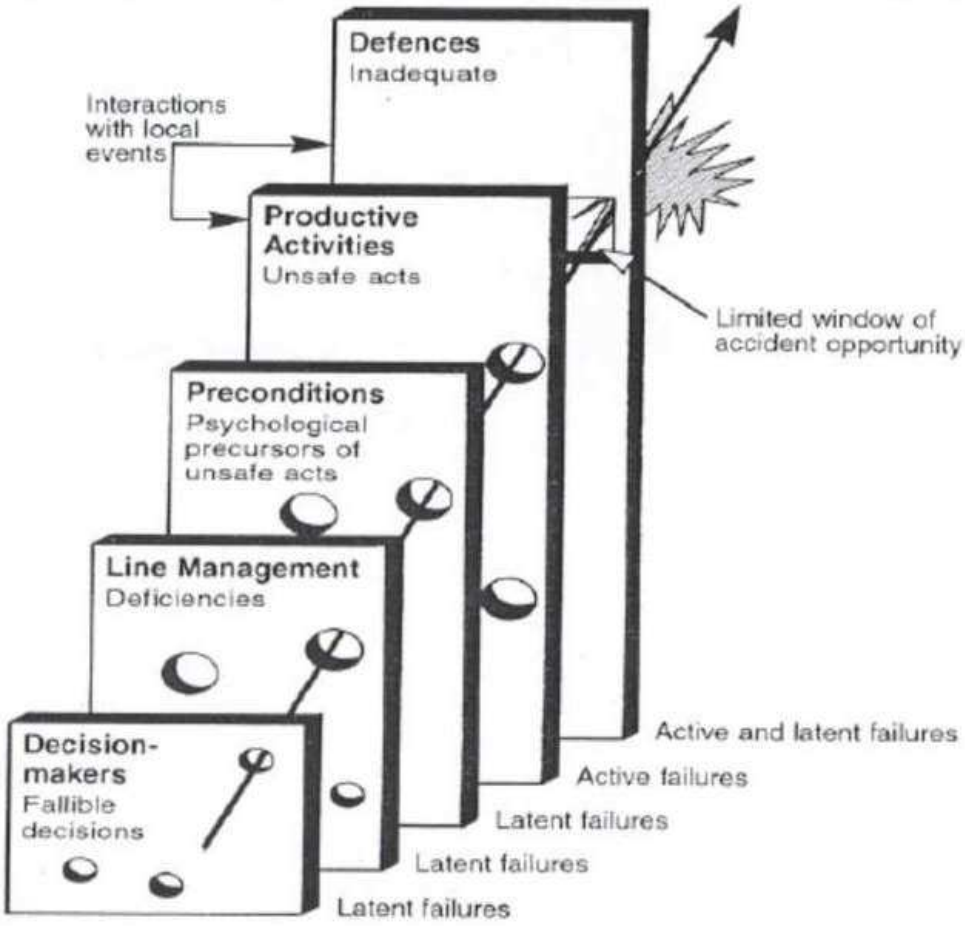
REASON

SHELL model



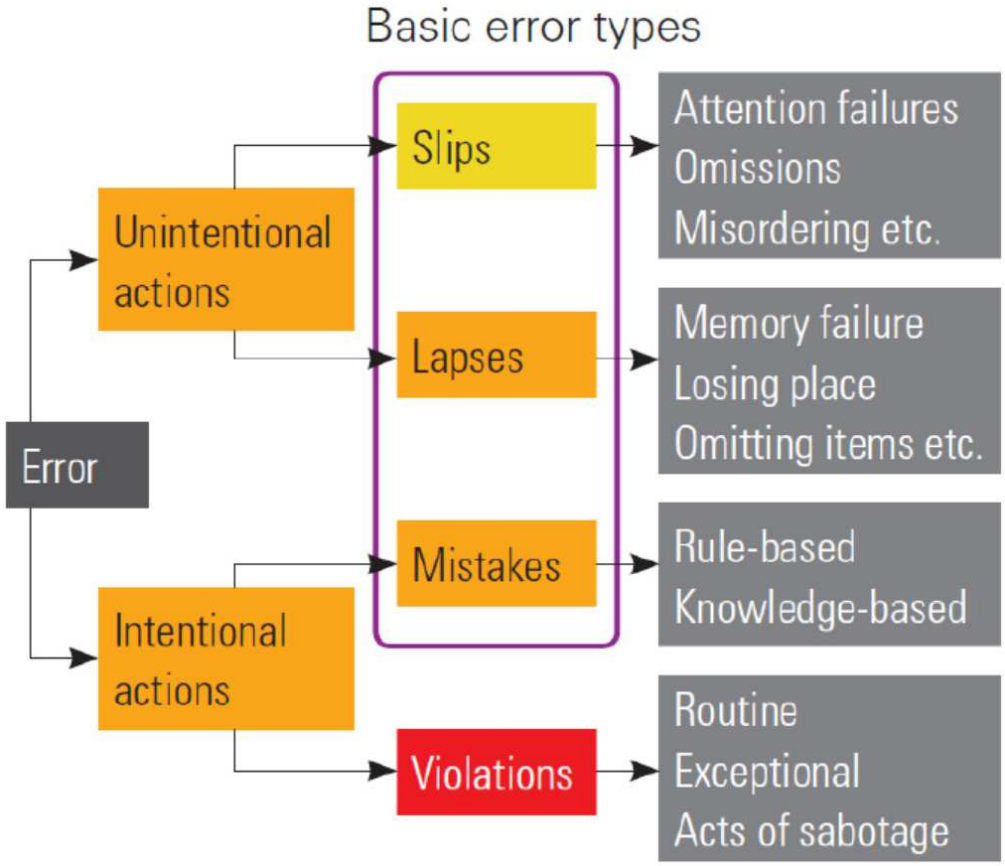
Source: http://aviationknowledge.wikidot.com/aviation:shell-model

Swiss-cheese model



Source: http://aviationknowledge.wikidot.com/aviation:accident-causation-model

Human Error (Reason)



Source: Human Error: Civil Aviation Safety Authority: SMS for Aviation–Human Factors a Practical Guide

Making errors is about as normal as breathing oxygen. (James Reason)

Bundesstelle für Flugunfalluntersuchung **QM104**

AZ:	Untersuchungsführer:	Datum:

Analyseformblatt

Warum	**Organisation / Organisational Influences**
	What could have been in place to minimize problems with the Risk Control? *Behördliche Überwachung, Organisationsstruktur, Change Management, hazard identification, interne Überwachung, Schwachstellenanalyse*
	>
Warum	**Sicherheitsmechanismen / Risk Controls**
	What could have been in place to reduce the likelihood or severity of problems at the operational level? *CRM Programm, Normal- und Notverfahren, Crew Zusammenstellung, Warnsysteme, Training(initial, recurrent),Equipment- und Cockpitdesign*
	>
Warum	**Spezifische Bedingungen / Local Conditions**
	What aspects of the local environment may have influenced the individual actions / technical problems? *Gesundheit, Arbeitsbelastung, Ermüdung, Wetter, Gruppenzwang, Erfahrung, Zwischenmenschliche Konflikte, Arbeitsbedingungen*
	>
Wie	**Person / Individual Actions**
	What individual actions increased safety risk? *Rule based mistake, knowledge based mistake, lapse ,slip, routine violation, perceptual error, lack of precision*
	>
Was	**Ereignis /Occurrence Events**
	Triebwerksausfall, CFIT, Staffelungsunterschreitung, Runway Excursion, Strömungsabriss, VFR in IMC, unstable approach, Vogelschlag
	>

Vorgeschlagene Sicherheitsempfehlungen:

	sofort	Adressat	Inhalt
1	☐		
2.	☐		
3.	☐		

Three Examples – same Problem

- Accident A320 in Warschow
- Serious Incident A320 in Hamburg
- Accident DHC-8 in Saarbrücken

Accident A320 in Warsaw 14.September 1993

Synopsis

DLH 3904 flight from **Frankfurt** to Warsaw progressed normally until Warsaw **Okęcie** TWR warned the crew that windshear exists on approach to RWY 11, as reported by DLH 5764, that had just landed. According to Flight Manual instructions PF used increased approach speed and with this speed touched down on **RWY** 11 in **Okęcie** aerodrome. Very fight touch of the runway surface with the landing gear and lack of compression of the left landing gear leg to the extent understood by the aircraft computer as the actual landing resulted in delayed deployment of spoilers and thrust reversers. **Delay** was about 9 seconds. Thus the braking commenced with delay and in condition of heavy rain and strong **tailwind** (storm front passed through aerodrome area at that time) aircraft did not stop on runway.

In effect of the crash one crew member and one of the passengers iost their lives. The **aircraft** sustained damage caused by fire.

Accident A320 in Warsaw 14.September 1993

3.2 Causes of the accident

Cause of the accident were incorrect decisions **and** actions of the flight crew taken in situation when the information about windshear at the approach to the runway was received. Windshear was produced by the front just passing the aerodrome; the front was accompanied by intensive variation of wind **parameters** as well as by heavy rain on the aerodrome itself.

Actions of the flight crew were also affected by design features of the **aircraft** which limited the feasibility of applying available braking systems as well as by insufficient information in the **aircraft** operations manual (AOM) relating to the increase of the landing distance.

Source: Investigation report of: **Main Commission Aircraft Accident Investigation WARSAW**

Serious Incident A320 Hamburg 01. March 2008

Summary

At 1630 hrs[1] on 1 March 2008, the German Federal Bureau of Aircraft Accident Investigation (BFU) was advised by Hamburg Airport that the left wing of an Airbus A320 had made contact with the ground during an attempted landing. In conformity with the Federal German Law Relating to the Investigation into Accidents and Incidents Associated with the Operation of Civil Aircraft (*Flugunfall-Untersuchungs-Gesetz - FlUUG*), this event was investigated as a 'Serious Incident'.

Because of the weather associated with hurricane Emma, on 1 March 2008 the Airbus A320 left Munich Airport on a scheduled flight to Hamburg at 1231hrs about two hours behind schedule, with a crew of five and 132 passengers. Given the ATIS weather report including wind of 280°/23 kt with gusts of up to 37 kt, during the cruise phase of the flight the crew decided on an approach to Runway 23, the runway then also in use by other traffic. During the approach to land, the aerodrome controller gave several updates on the wind. Immediately prior to touchdown, the wind was reported as 300°/33 kt, gusting up to 47 kt. At the time of the decrab-procedure there was no significant gust.

The initial descent was flown by autopilot and the co-pilot assumed manual control from 940 ft above ground.

After the aircraft left main landing gear had touched down, the aircraft lifted off again and immediately adopted a left wing down attitude, whereupon the left wingtip touched the ground. The crew initiated a go-around procedure. The aircraft continued to climb under radar guidance to the downwind leg of runway 33, where it landed at 1352 hrs. No aircraft occupants were injured. The aircraft left wingtip suffered damage from contact with the runway.

Serious Incident A320 Hamburg 01. March 2008

This serious landing incident took place in the presence of a significant crosswind and immediate causes are as follows:

- The sudden left wing down attitude was not expected by the crew during the landing and resulted in contact between the wingtip and the ground.
- During the final approach to land the tower reported the wind as gusting up to 47 knots, and the aircraft continued the approach. In view of the *maximum crosswind demonstrated for landing,* a go-around would have been reasonable.

The following systematic causes led to this serious incident:

- The terminology *maximum crosswind demonstrated for landing* was not defined in the Operating Manual (OM/A) and in the Flight Crew Operating Manual (FCOM), Vol. 3, and the description given was misleading.
- The recommended crosswind landing technique was not clearly described in the aircraft standard documentation.
- The limited effect of lateral control was unknown.

Accident DHC-8 in Saarbrücken 30. September 2015

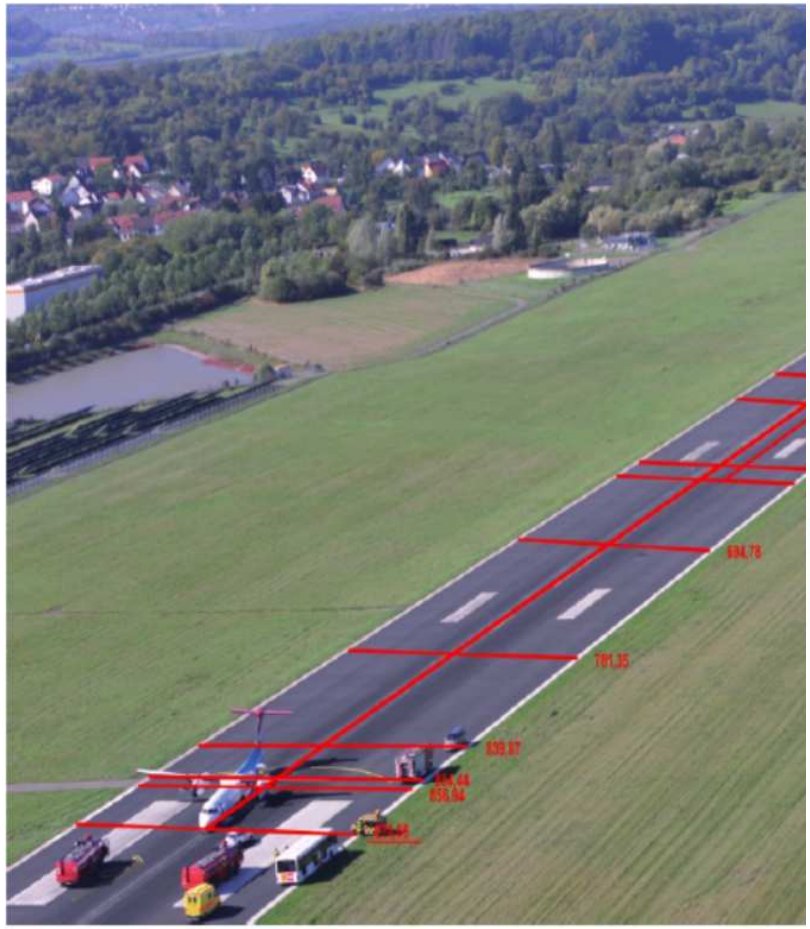
Factual Information

During take-off from runway 09 at Saarbrücken Airport the landing gear retracted in the rotation phase. The airplane came to a stop approximately 425 m prior to the end of the runway. It rested on the fuselage and was severely damaged. Persons were not injured.

CVR ->

1016:24	PF	take off, my controls
1016:25	PNF	your controls
1016:27	PNF	spoiler is closed
1016:30	PNF	autofeather armed
1016:33	PF	looks like spring
1016:35	PNF	yeah, power is checked
1016:36	PNF	80 knots
1016:37	PF	checked
1016:40	PNF	V_1, rotate
1016:42	Background	click sound, probably gear lever UP
1016:43	PNF	upps, sorry

Accident DHC-8 in Saarbrücken 30. September 2015



Overview skid marks and final position of the airplane

Damage on the fuselage's bottom surface (in flight direction)

Photo: BFU

Accident DHC-8 in Saarbrücken 30. September 2015

After the salvage operation the airplane was jacked up and the function of the retractable landing gear checked. The test was repeated several times and neither test showed any malfunction of the landing gear, the operation controls or indications.

It was determined that the landing gear already retracts if the nose landing gear is airborne (Weight-on-Wheel switches -> air) but the main landing gears are still on the ground (WOW sws -> ground). The system design responsible stated that this corresponded with the design logic.

Summery for this 3 examples

The pilots did not really know,

what the aircrafts systems exactly do

in the case of

one or more landing gears

are not on the ground.

Summery for this 3 examples

Why do we know this?

- Get all factual information you can get
- Make an analyses
- Build up the event tree
- Find the causes
- Formulate the safety recommendations

Investigation into incidents

Study of Reported Occurrences in Conjunction with Cabin Air Quality in Transport Aircraft

Published by BFU in 2014

Synopsis

Over the last few years, the German Federal Bureau of Aircraft Accident Investigation (BFU) has received an increased number of reports of so-called fume events[1]. These kinds of events include smell, smoke or vapour inside the airplane and health impairments of occupants of transport aircraft. In addition, this topic is increasingly discussed among flight crew, occupational unions, the media and in political committees.

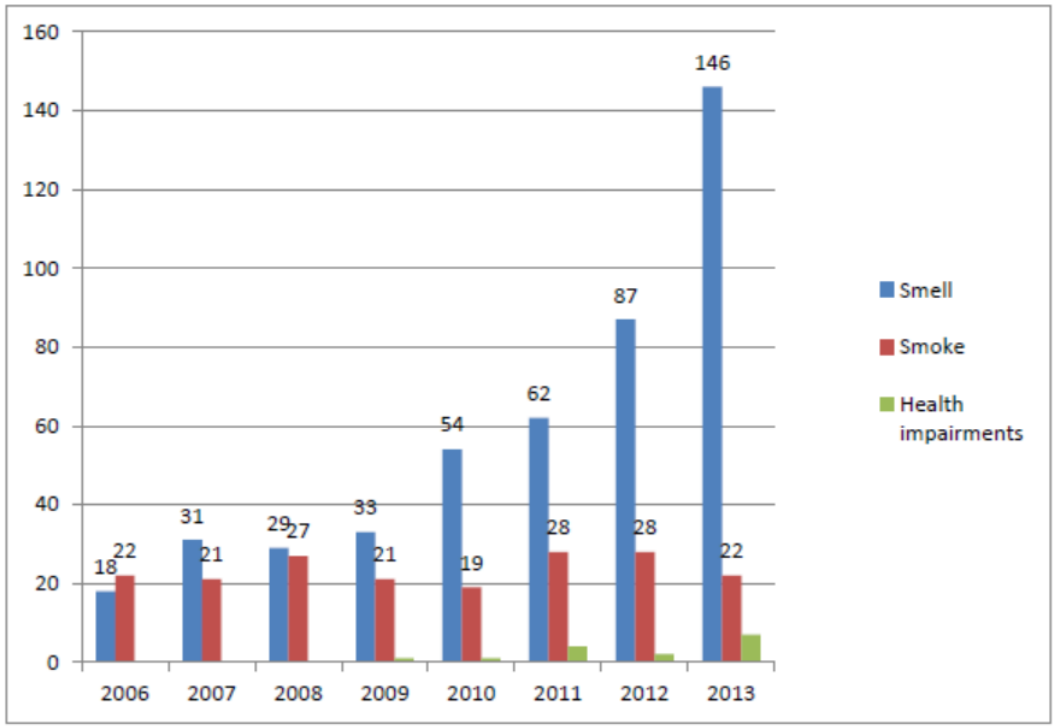
The study is based on the Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation. Taken into account were 845 accidents, serious incidents, and incidents, which have been reported to the BFU between 2006 and 2013.

A conjunction with cabin air could be determined in 663 reports. In 180 reports health impairments were described although a conjunction with cabin air quality could not be determined.

In 460 of the 663 reported fume events smell development and in 188 cases smoke development was reported. In 15 cases there was neither smell nor smoke but there were certain health impairments which may possibly have a conjunction with a fume event.

A total of 663 fume events were reported during the period under review. In 460 of them smell and in 188 smoke was reported. In 15 cases there was neither smell nor smoke but there were certain health impairments which may possibly have a conjunction with a fume event.

The break-down of the reports classified as fume events reported between 2006 and 2013:



Reports with smell, smoke, health impairments

1.1 Aim of the Study

For the last several years, flight crew, occupational unions, media, and political committees have increasingly been discussing fume events. The number of reports of such events the BFU receives has also increased. Fume events are occurrences which include smell, smoke or vapour inside the airplane and health impairments of occupants of transport aircraft.

By the investigation of the reported events with the available methods for the investigation of accidents and serious incidents the BFU encounters limits. On the one hand it is the high number of reports and on the other the possibilities to gather verifiable facts in a timely fashion are limited. The processing of these events has shown that in many of these cases access to data and evidence of possible technical malfunctions of aircraft systems and the compilation and assessment of medical data is either very limited or not possible at all.

...

...

Based on the received reports and the findings of investigation activities, it is the experience of the BFU that these fume events necessitate a differentiated examination. The spectrum regarding the importance and severity of the events ranges from harmless smells or slight smoke development to impairment due to eye or nose irritations, to impairment of the capability to act of flight crew (incapacitation) to the point of possible long-term impairment.

Based on this, the BFU decided to examine the topic in the scope of a study. The study is based on the Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and it summarises and analyses events which had been reported to and investigated by the BFU.

The fume events taken into account in this study showed that no significant reduction of flight safety occurred. The study shows that fume events occur and can result in health impairments. With the methods of air accident investigation, the BFU cannot assess the possible long-term effects of fume events.

The German Federal Bureau of Aircraft Accident Investigation has issued four safety recommendations. They refer to:

- An improved identification and avoidance actions of cabin air contamination possibly hazardous to health.
- A standardised reporting procedure
- Improvement of the demonstration of compliance of cabin air quality during the certification process of transport aircraft
- Assessment of a possible conjunction between long-term health impairments and fume events by a qualified institution.

2.7 Scope and Limits of the Investigation by BFU

The BFU is the responsible authority for the investigation of accidents and serious incidents, but for the investigation of fume events the options are limited. The BFU has stated that based on legal requirements the investigation of an incident not classified as accident or serious incident can only be an exception.

The mode of operation of the BFU, as well as any other safety investigation authority, is such that due to a concrete occurrence, facts are determined which allow assessment of the cause. This means, the causal connection between the fume event and the health impairment has to be established.

Even though the BFU does not question these illnesses, the causality cannot be determined with the current methods and means of air accident investigation.

To determine the causality it would be necessary to preserve the cabin air at the time of the event so that it can be examined as to its properties and contaminations. Part of the investigation is verifiable medical diagnoses. Inspections of the airplane and the engines are also necessary.

So far, the BFU could not establish the causality of a fume event as described above.

Investigating into Incidents

The three monkeys Source: http://www.persoenlichkeits-blog.de/

- Nothing seen
- Nothing heard
- My company doesn‘t want to get into the focus
- Don’t ask more questions! That … is quiet normal.

Thank you for listening

Questions/Disscussion