

Shoreham

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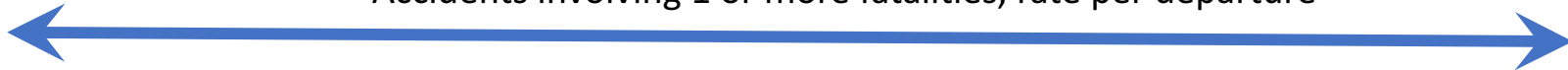
This presentation is based on a published AAIB report and includes figures from the report.
The views of the speaker are his own and do not represent the AAIB position.

If there are any differences the published report shall prevail

How much risk?



Accidents involving 1 or more fatalities, rate per departure



1 : 2,300

Kjerag massif, Norway

Source: Soreide K et al, J Trauma 2007 May 62(5):113-7

1 : 111,000,000

IOSA accredited operators

Source: IATA 2016 Safety Report p51



Figure 27

2 km radius of Shoreham with congested and high density areas shown in grey

Planned Manoeuvre

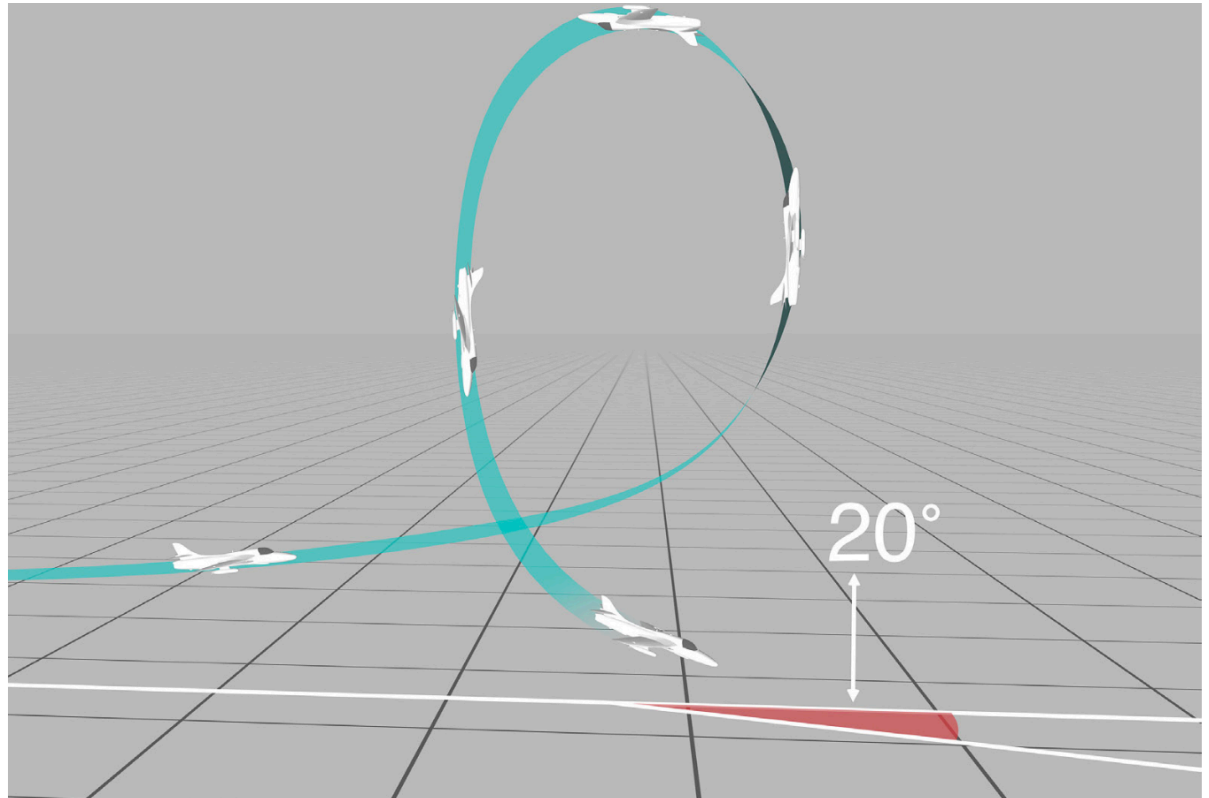


Figure 23

Manoeuvre with vertical component and roll resulting
in a change of ground track



Video courtesy of DanTube

Outcome

A/C impacted road at 225 kt,
14 deg nose up

Mass 17,000 lbs

11 Fatalities, 13 Injured



© Sunday Mirror

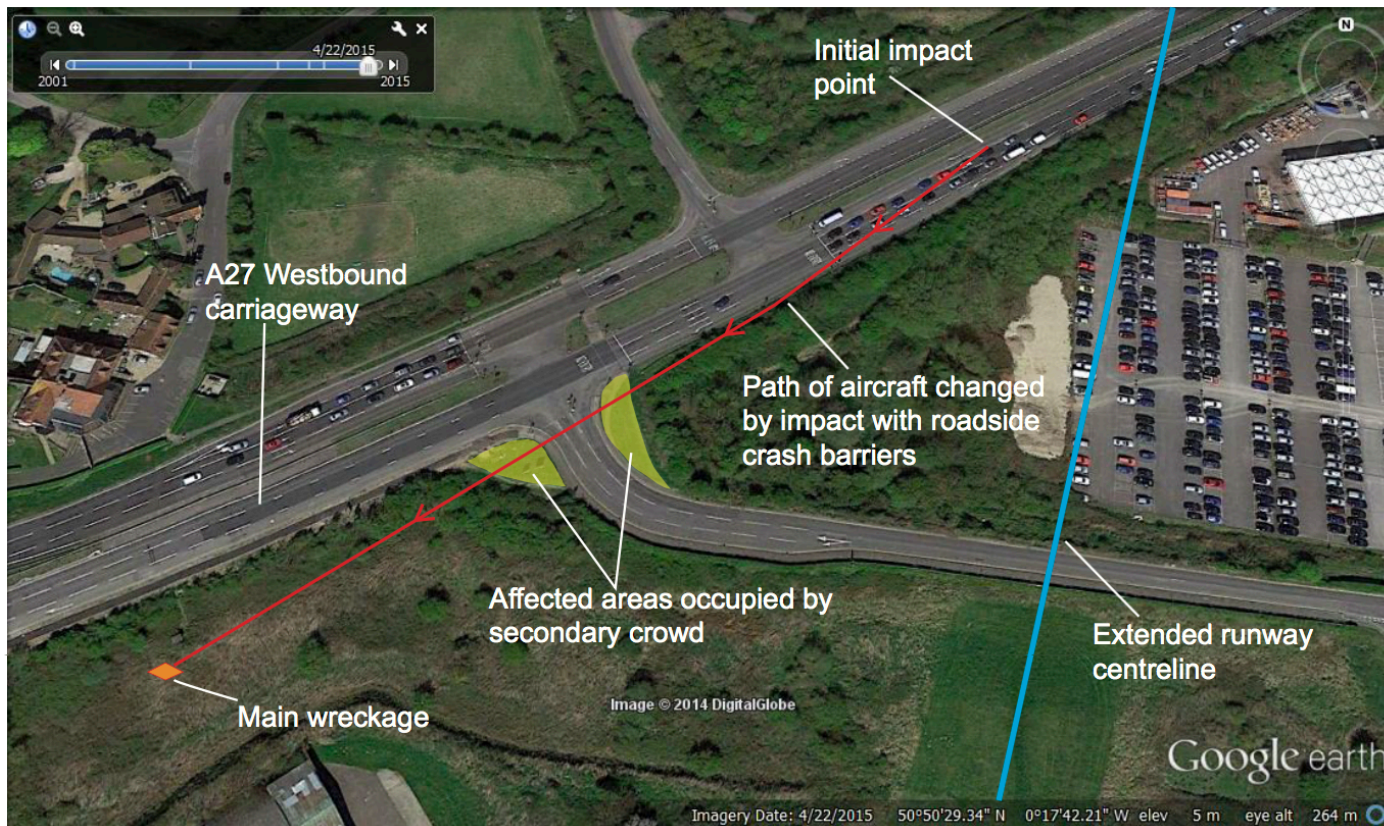


Figure 16

Illustration of accident site location (image not from the day of accident)

Source AAIB report

Cockpit Camera



- GPS
- Radios
- JPT
- Engine speed (only visible when pilot moves)
- Fuel controls and indicators
- Oxygen controls and indicators
- Right ASI- partially obscured
- G-meter
- Right control stick (when in field of view)

Source AAIB

Complicating factors:

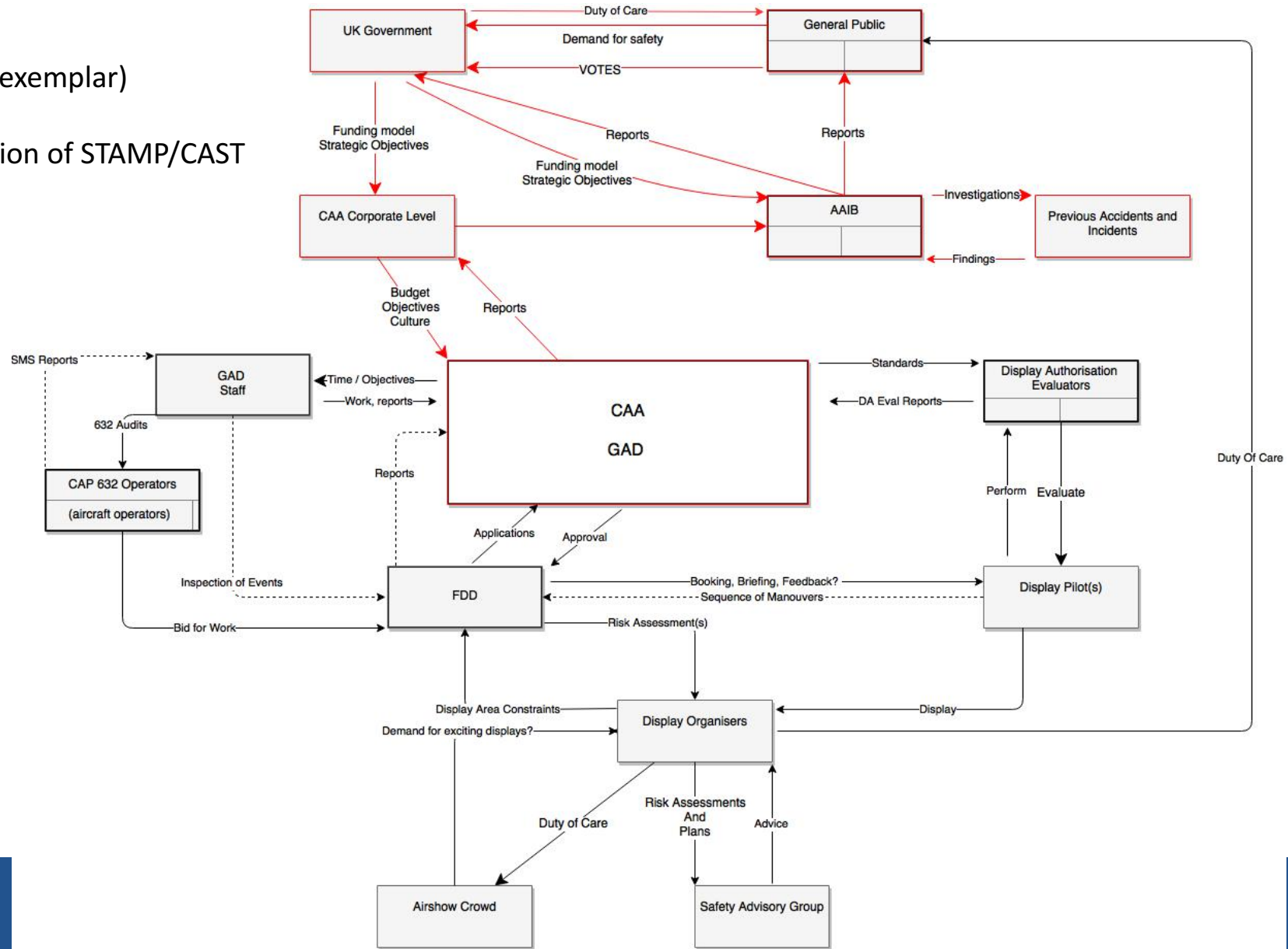
- Ongoing parallel police investigation
- *'The AAIB was not able to question the pilot on his conduct of the accident flight'*

External support

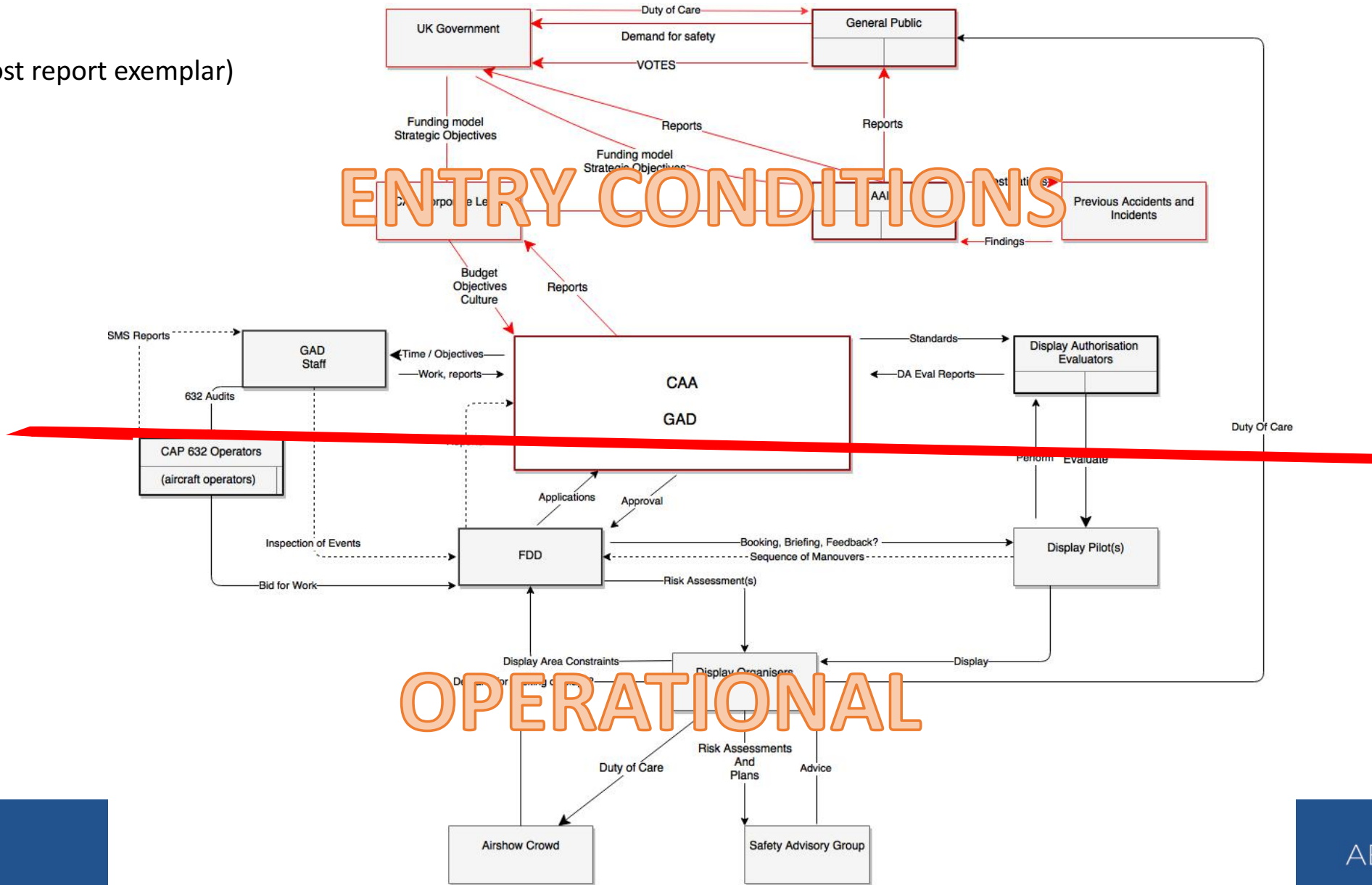
- RAF-CAM
- Subject Matter Expert -test pilot
- Health and Safety Labs (risk management)

(Post report exemplar)

Scrappy version of STAMP/CAST



(Post report exemplar)



Feedback loops:

- No requirement for FDD to report
- No formal recording system
- No SMS from operators

- 2014:
- 281 Display Approvals
- 8 inspections (2.8%)

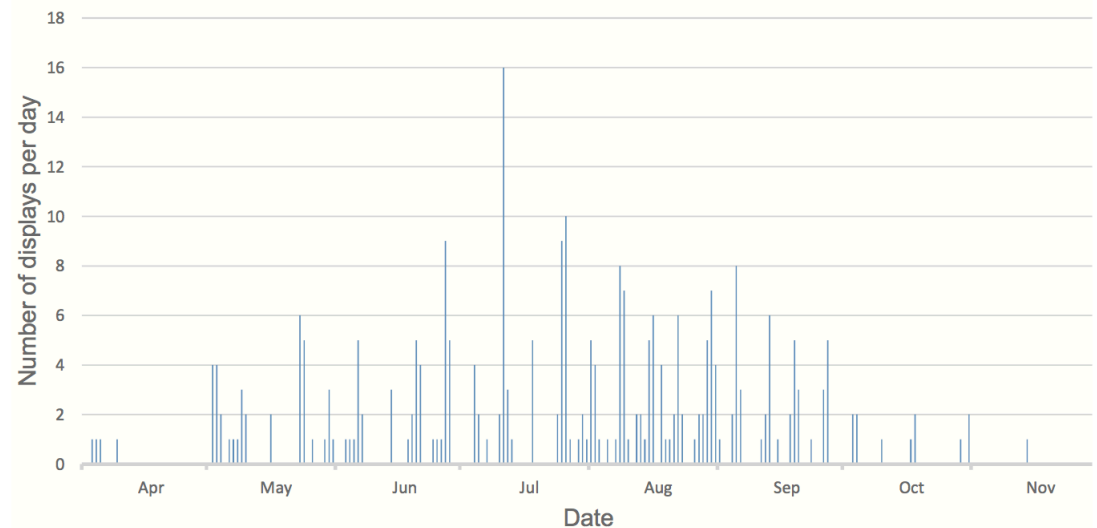
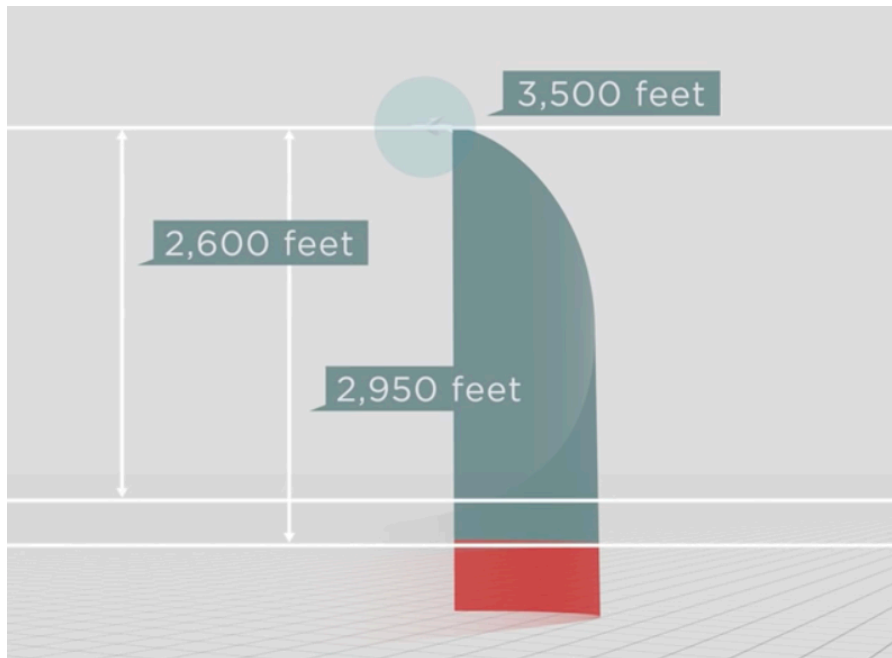


Figure 26

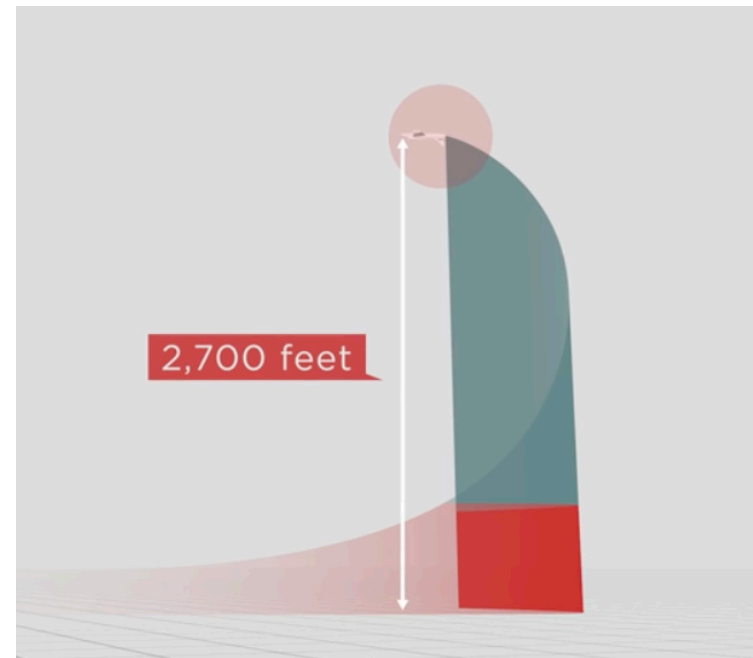
Distribution of flying displays in the UK in 2015 by month

“Planned” v Actual

**Entry 500 ft agl, 350 kt+,
Apex speed about 150 kt**



**Entry 185 ft agl (+/- 35ft) , 310 kt (+/- 15)
Apex speed 105 kt**



Lower
entry
airspeed



Less
than full
thrust

Lower
than safe
apex

Decision Points

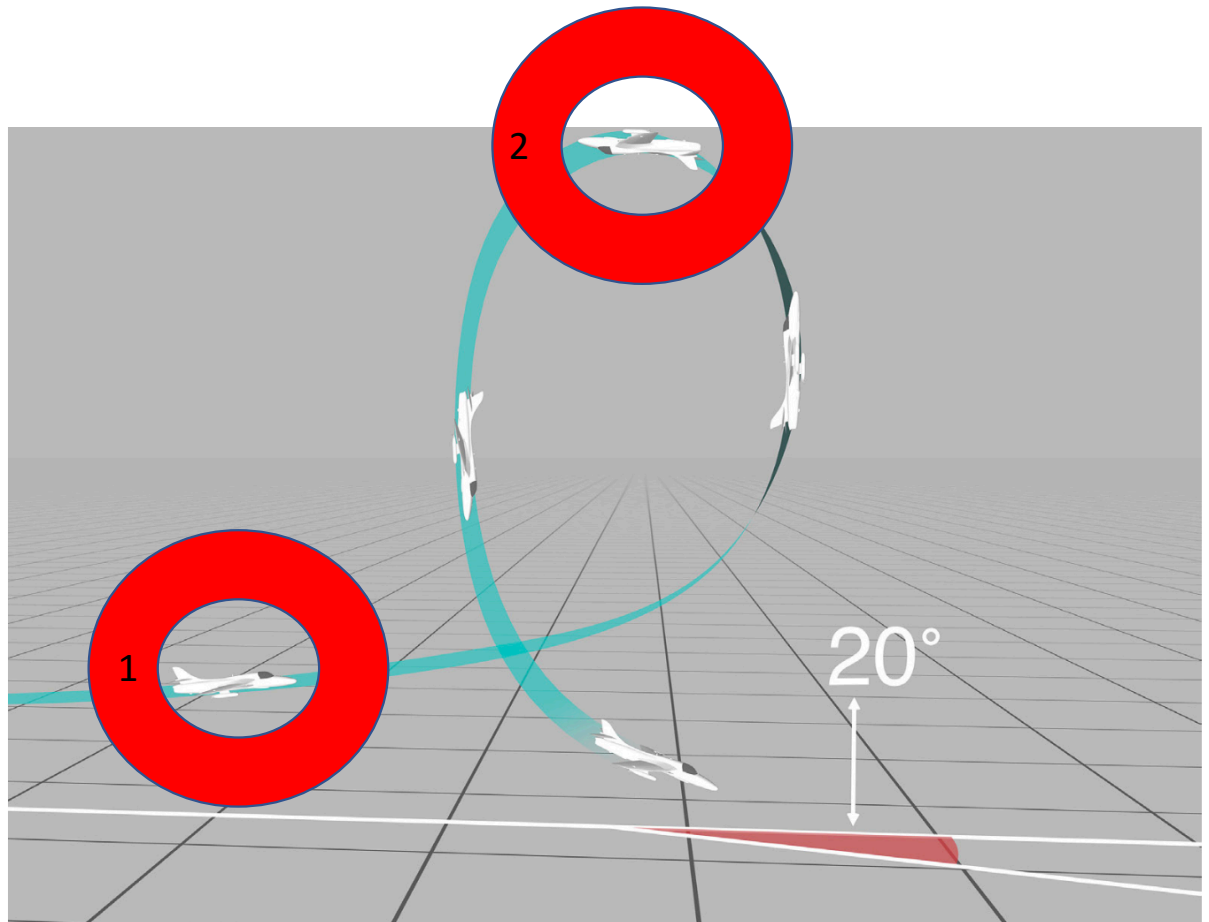


Figure 23

Manoeuvre with vertical component and roll resulting in a change of ground track

Decision Point 1

Speed	Pilot uses 350 min
299 or below	No
300-349	No
350+	Yes

Adapted from Table 1 on Page 410 AAIB report

Information about aircraft speed not obtained



Figure 4

Munro Mk 12A Airspeed indicator

- Scan pattern
- Workload
- Allocation of attention
- Change blindness
- Distraction
- Instrument contrast.
- Glare

Inaccurate information obtained about airspeed



Figure 4

Munro Mk 12A Airspeed indicator

- Airspeed indicator displayed the incorrect speed
- Airspeed display misleading or ambiguous
- Another dial read as airspeed
- Global Positioning System (GPS) read as airspeed
- Airspeed was misread.

Decision
Points

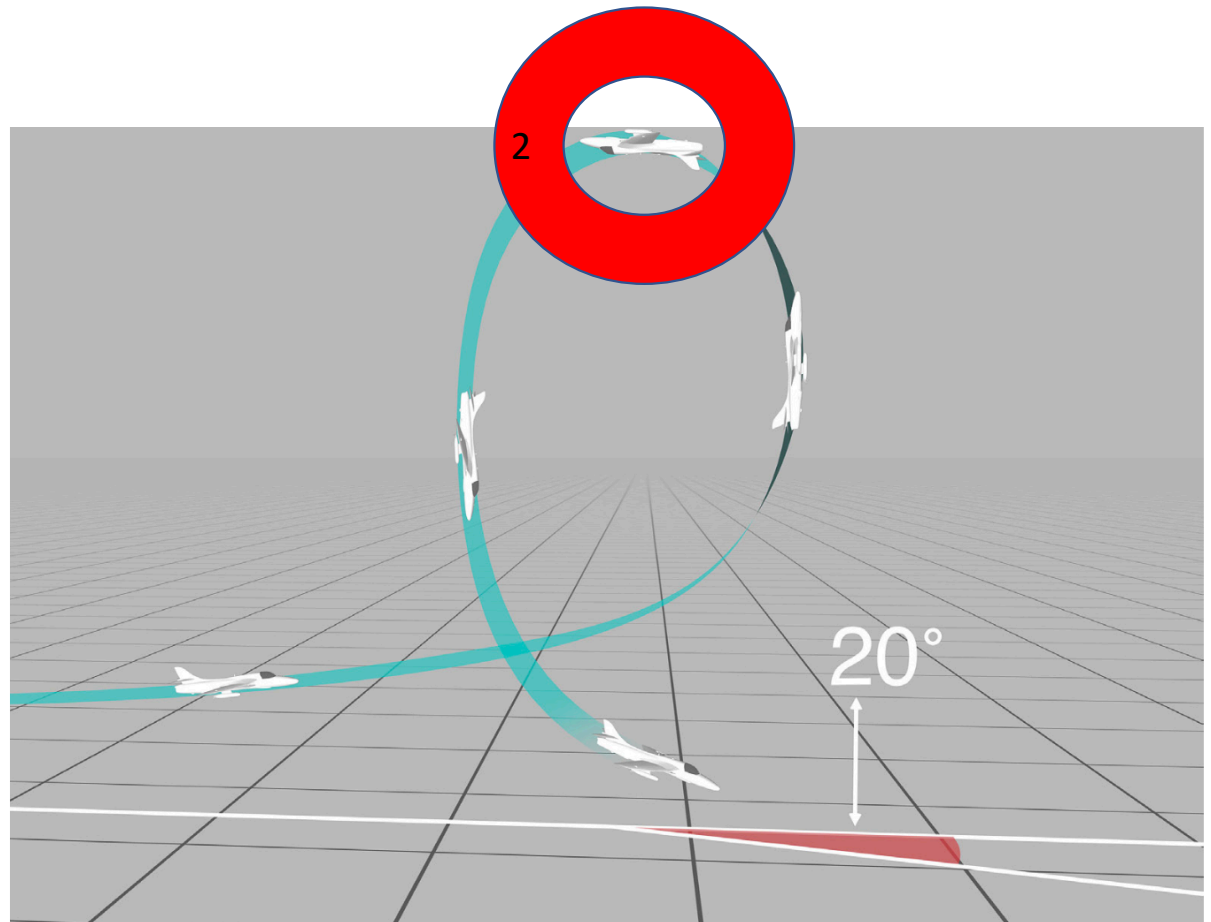


Figure 23

Manoeuvre with vertical component and roll resulting
in a change of ground track

Is there sufficient height to complete?

- 3,500 ft min v 2,700 ft achieved
- So why might the manoeuvre continue?

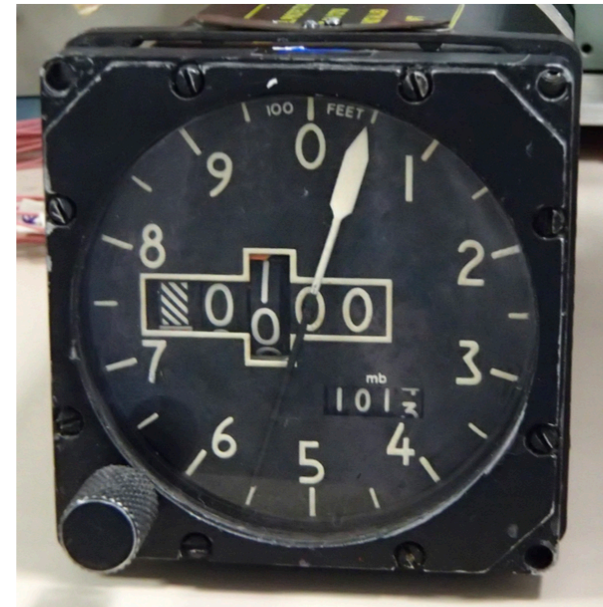


Figure 5

Mk 30B altimeter (barometric pressure setting not as found)

Rule based error...?

- Especially important in marginal scenarios where the rule is intended to be the arbiter between safe and unsafe system state.
- Yet...rules are particularly vulnerable in ambiguous scenarios.



Figure 28

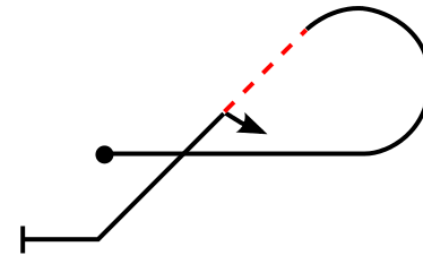
Altimeter height counter partially obscured by pointer
(Barometric pressure setting not as found)

Richard Clewley & Edward J.N. Stupple (2015): The vulnerability of rules in complex work environments: dynamism and uncertainty pose problems for cognition, Ergonomics

- Pilots reported a significantly increased likelihood of failing to apply the SAC rule under conditions of high uncertainty...
- This is illustrated by taking the reverse view: the rule is more reliable under conditions of certainty, or relative ease in determining the final system state.

Ambiguity...CAP 743

- ...for example, if you don't see 1,500 ft at the top of a vertical then only do a triple flick on the down 45 line instead of a quadruple – dump one rotation. If you don't see 1,400 ft then only do a double flick: if you don't see 1,300 ft only do one aileron roll



Or...Right rule, wrong context?

Entry 185 ft agl (+/- 35ft) , 310 kt (+/- 15). Apex 2,700 ft @ 105 kt



Loop entry		Loop apex	
Indicated altitude (±50 ft)	Indicated airspeed (±5 KIAS)	Indicated altitude (±100 ft)	Indicated airspeed (±10 KIAS)
200	270	2,750	125
200	270	3,150	105
200	260	2,800	110
300	260	2,900	130

Table 6

Jet Provost loop parameters the weekend prior to the accident

Remember this?



Accidents involving 1 or more fatalities, rate per departure

1 : 2,300

Kjerag massif,

Source: Soreide K et al, J Trauma 2007 May 62(5):113-7

UK Display Flying 1 : 2,950

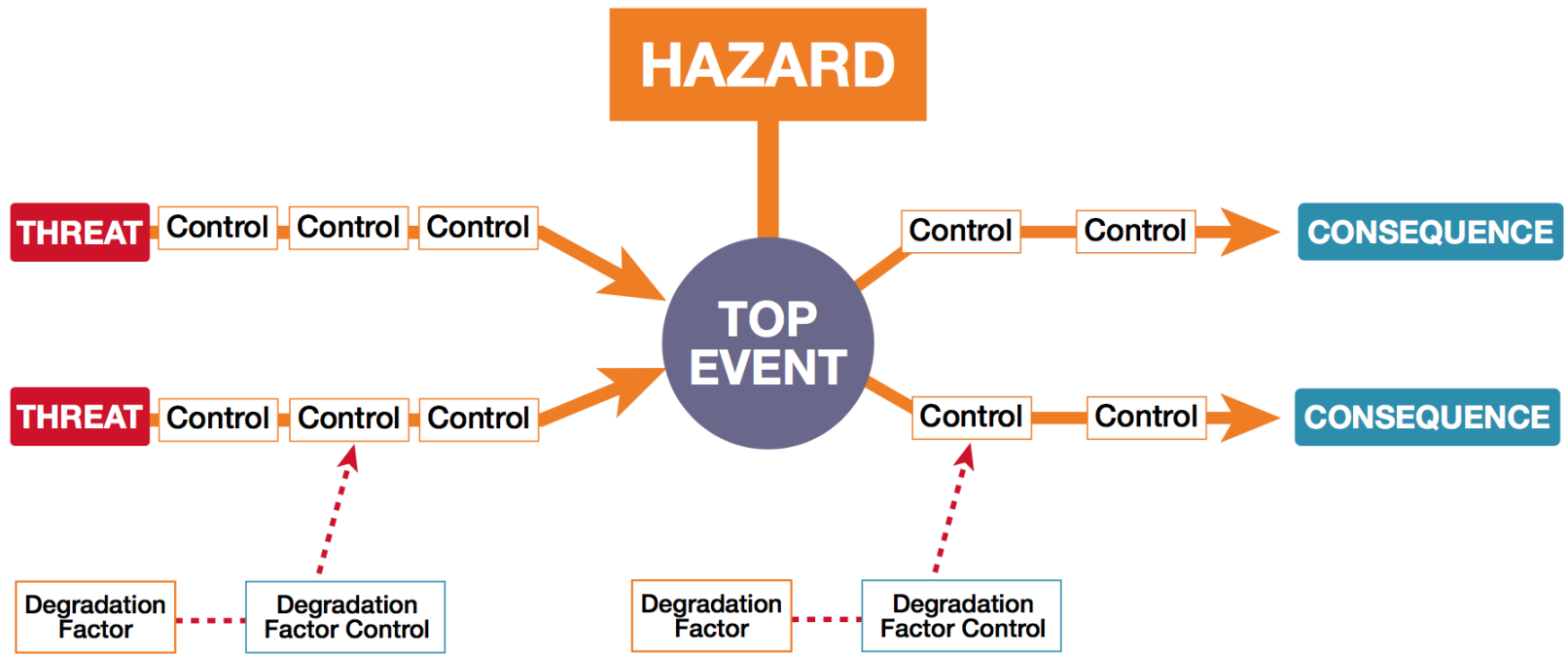
Average 2008-2015 Source: AIB report p105

1 : 111,000,000

IOSA accredited operators

Source: IATA 2016 Safety Report p51





Source: 'HF in Barrier management'
 Chartered Institute of Ergonomics and Human Factors

Preventive controls

- Initial and recurrent training programmes
 - Pilot Currency
 - Operator Procedures
 - Regulatory Requirements for Pilot competency
 - Monitoring by the pilot
 - External Monitoring
 - SMS
- Regulation of complex aircraft
 - Safety Culture
 - Regulatory Oversight
 - Design of the display environment
 - Risk assessments (and guidance for how to)
 - Regulation of displays

Sorry Steve

Recovery Controls

- External Monitoring detects missed gate
- Pilot performs an escape manoeuvre having recognised it was needed
- Separate the consequences from uninvolved third parties
- Separate the consequences from involved third parties
- Pilot Ejects
- Mitigate risk to responders

Thank you... any Questions?

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