The Kegworth Air Accident – Safety Lessons Learned
Dr Mike Bromfield and Prof Mike Blundell (Coventry University)

The speakers started their presentation by showing video of a 'breaking news' story on BBC television on the night of the accident. Many people in the audience could remember what they were doing when they saw this broadcast, reinforcing that as well as being one of the most significant accidents in recent UK aviation history, it had a great impact in this locality.

The British Midland operated Boeing 737-400 crashed during an approach to East Midlands Airport on 8 January 1989, and of 118 passengers and 8 crew on-board, 47 became fatalities, 5 people 'walked away' and all other 74 survivors were rescued: a large proportion of them with serious injuries. The aircraft had diverted, having commenced a flight from Heathrow to Belfast and suffered an engine failure at 29,000ft. The flight crew correctly completed the procedure for an engine shut-down, but inadvertently shut-down the wrong engine, and almost illogically the damaged engine was still providing what seemed to be normal power. While on approach to East Midlands Airport, and as it passed over Kegworth, the damaged engine was commanded to increase power but it failed catastrophically. The aircraft impacted several hundred metres short of the runway, then cut through trees before it crossed the M1 and rammed into the western embankment, adjacent to the runway approach lights, at a speed of around 100kts (115mph). The undersides of the fuselage tail and nose sections were damaged in the two impacts, and the fuselage broke in two places in the course of the rapid 22-26g deceleration sustained during the final impact.

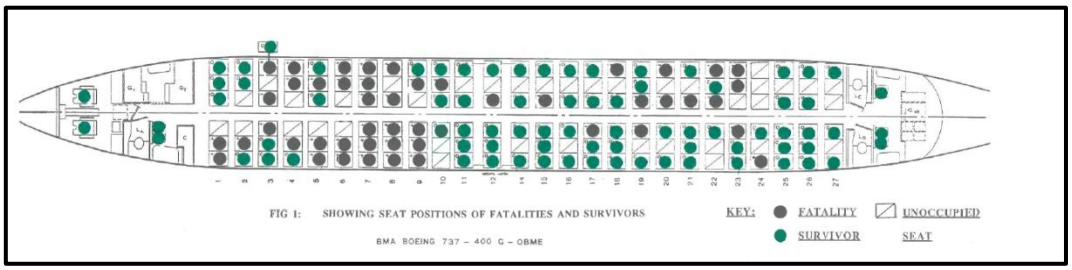
After describing these events the speakers concentrated on the conclusions of the UK Air Accident investigation Branch (AAIB) report on the accident, reviewing in depth the contribution of human factors, the survivability aspects of the aircraft and post-crash events, and referring to Coventry University research to illustrate lessons learned from the accident.

The most significant contribution to the accident was the engine failure, and the decision by the crew to shut-down the wrong engine. The presentation showed instrumentation changes between Boeing 737-300 and 737-400 and commented on the lack of a UK-located flight simulator for 737-400 for crew competence checks (it was a relatively new model of the widely-used 737 airliner) and the way that air-conditioning system configuration changes introduced cues leading to the crew's misidentification of the correct engine to shut-down. Also, passengers and cabin crew saw the left-hand engine emit flames (as the engine fan failed the engine surged, and the damaged fan continued to rotate, with vibrations) but this was not reported to the flight-deck. Crew 'fixation' and 'laterality' preferences led to the crew making the wrong decision. These human factor aspects were illustrated with a film and a vision-test that invited audience participation and responses were indicative of the tendency for people concentrating on a given task to miss a significant event (fixation) and for left-handed and right-handed people to make opposing judgements of the same situation (laterality). The failure to communicate vital information from cabin to flight-deck at Kegworth also led to Cockpit Resource Management (CRM) training in airlines worldwide – aimed at promoting the sharing of information between the pilot in command and the monitoring pilot, whatever their position or rank – being re-modelled as 'Crew' rather 'Cockpit' related, and promoting improved communication between all commercial aircraft crew members. In reviewing the wider aspects of the findings, reference was made to the Swiss Cheese Model (introduced by James Reason and used widely now in aviation), which

refers to causal influences as lining up – like holes in slices of Swiss Cheese – and used a four element model, bringing together 17 aspects of organisation, supervision, environment and personnel together with the errors and violations that arose from an analysis of the accident events.

Survivability at Kegworth was governed mainly by what protection was available for the occupants. The presentation reviewed how relatively crude computer-based modelling of impact effects was available then, and how it has improved considerably throughout the ensuing years. A neatly illustrated paradox showed that while the low-wing Boeing airliner's passengers survived in the centre section (above the wing root) the failure of a high-wing airliner's fuselage in a drop test resulted in least survivability in that same region. Drop-tests have been used to calibrate computer models – but one test with a helicopter fuselage was reported to require 300,000 Euros of funding, and only one adequately equipped facility is now available in Europe – at CIRA, near Naples, in Italy. Real-time and slow-motion footage of tests, and comparable results from modelling were shown. These included examples of impact with restrained (seat-belt) occupants in a helicopter, and the same test with airbag protection for the pilot. These showed how more confidently a design can be assessed using computer-based tools to improve protection for passengers and aircrew in modern airliners.

As well as restraint protection, there was consideration of seat attachment and the susceptibility to structural deformation. Of 52 triple-seat units in the Kegworth aircraft, 21 remained full-attached; 14 of these were in the over-wing section and 7 were in the aft fuselage. Attention was devoted also to seat design, with the protection of passengers in the brace position or with airbags discussed, and the implications on seat design of the fact that 69 passengers suffered lower limb injuries – mostly incurred through impact with the seat in front - as their legs flayed in the sudden deceleration.



This illustration of survivor and fatality distribution in the cabin is from the AAIB report on the Kegworth accident. This comprehensive report can be downloaded on-line at http://www.aaib.gov.uk/cms_resources.cfm?file=/4-1990%20G-OBME.pdf

The speakers summarised their review of how accident investigation and the implementation of lessons learned has contributed to improvement in the accident rate (per flight) in international airline operations, citing ICAO statistics that showed a 75% decline from 1989 to 2008. Tools and techniques to minimise impact-related injuries remain in development, and the human factors base analysis of accidents and incidents is still contributing to operational performance improvements.

Ivor Amos presented the vote of thanks to an appreciative audience of about 230 people which included residents of Kegworth village near to the crash site.

Lecture notes by Mike Hirst.