Flight Data Analysis – An Airline Perspective

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Biography

Neil Campbell  B Eng (University of WA)
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Neil has over 17 years experience in the field of aviation safety and is a member of the International Society of Air Safety Investigators (ISASI).

After graduating in 1983 with a Bachelor of Engineering degree (Electronics) from the University of Western Australia, Neil joined the Department of Defence (Navy Office) as a civilian engineer. He worked in the Directorate of Naval Electrical Design and the Directorate of Naval Weapons Design.

In 1986 Neil joined the Bureau of Air Safety Investigation, now known as the Australian Transport Safety Bureau (ATSB), as an Air Safety Investigator and flight data recorder specialist. While at the ATSB he replayed, analysed and presented recorded data in support of accident/incident investigations and also conducted flight data recorder readouts on behalf of government authorities and airlines in the Asia-Pacific region including Singapore, Indonesia, New Zealand, Sri Lanka, New Guinea and the Philippines.

During 1998 he was a member of the ICAO Flight Recorder Panel which developed changes to ICAO Annex 6.

In February 2000, Neil joined the Corporate Safety Department of Cathay Pacific Airways Limited in Hong Kong. During 2001 and 2002 he held the position of Manager Air Safety. His duties included incident investigation, flight crew safety awareness briefings, participating in safety review committee meetings and managing the flight data analysis program.
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Photographs courtesy of Samuel Lo
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Airline Use of Recorders

- Cockpit Voice Recorder (CVR)
  Replayed annually: 0

- Flight Data Recorder (FDR)
  Read out annually: 12

- Quick Access Recorder (QAR)
  Read out annually: 3,500  (80% of all sectors flown)
History of QAR

• 1964 First autoland achieved
• QAR developed to meet regulatory requirements to validate autolands
- 60,000 parameters available
- 2,000 recorded by QAR
- 700 recorded by FDR
A340-600

- DAR records 600 parameters
- Data stored on magneto-optical disk
- Removed manually (every 5 days)
Space Shuttle Columbia
OEX Recorder
Uses of QAR Data

- Engineering Analysis/Troubleshooting
- Regulatory Requirements
  eg. Autoland validation
- Incident Analysis
  eg. Data supplied to manufacturer
- Flight Data Analysis Program
Flight Data Analysis Program

- Flight Data Analysis (FDAP)
- Flight Operations Monitoring (FOM)
- Flight Data Monitoring (FDM)
- Flight Operations Quality Assurance (FOQA)

- ICAO Annex 6 Standard:
  From January 1st 2005 an operator of an aeroplane of a MCTM 27 tonnes shall establish and maintain a flight data analysis program …
Flight Data Analysis Program

• Identify and quantify existing operational risks

• Identify and quantify changing operational risks

• Formally assess the risk to determine which are not acceptable

• Where risks are not acceptable, put in place remedial activity

• Measure the effectiveness of action and continue to monitor risks
Flight Data Analysis Program

- Event Detection

- Data set from every flight (typical operating boundaries)

- On request provide direct feedback to crews
Typical Events

- GPWS / TCAS Warnings
- Limit Speeds (VMO, MMO, Flap & Gear)
- Take-off/Landing Speeds
- Pitch/Roll Limits
- Rushed Approaches (Late Landing Flap, High ROD’s)
Event Detection

High Pitch on Landing Triggered an Event
An Approach with 3 Events

Event 22C Detected
High ROD 2,000 - 1,000 ft AAL
ie. > 1700 fpm

Event 22B Detected
High ROD 1,000 - 400 ft AAL
ie. > 1200 fpm

Event 6A Detected
High Approach Speed
ie. > 180 knots within 90 seconds of touchdown

CAS (knots)
Altitude (feet AAL) and ROD (fpm)

Time (seconds) Before Touchdown
Figure 3: actual and predicted distribution of events amongst 747-400 pilots

- 8 pilots had 5 events
- 3 pilots had 6 events
Event Issues

• False/Reject Events

• Turning Data into Information

• Cost

• Lack of standards

• Event Rates
Event Analysis Issues

• What are the most significant events?

• No details from crew

• Easy to identify trends?

• Tackling systemic problems?
Flight Data Analysis Program

• Event Detection

• Data set from every flight (typical operating boundaries)

• On request provide direct feedback to crews
Altitude At Which Landing Flap Is Set

Altitude (feet AAL)
Flight Data Analysis Program

- Event Detection

- Data set from every flight (typical operating boundaries)

- On request provide direct feedback to crews
Engine Shutdown

• A330 In-flight Engine Shutdown

• ECAM “ENG 1 OIL LOW PRESS.”

• QAR “Low Oil Pressure ENG 1” parameter indicated “Not Low Pressure”
Engine Shutdown

• FWC/EEC software mismatch

• Complex aircraft - need a lot of data from multiple sources

• Software configuration control
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