Flight Data Analysis – An Airline Perspective

Neil Campbell

Aviation Safety Consultant

Biography

Neil Campbell B Eng (University of WA)

Aviation Safety Consultant

Email: neilahcampbell@gmail.com

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.

Acknowledgement:

Photographs courtesy of Samuel Lo

(email: samuel_lo@cathaypacific.com).

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

B777

- 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

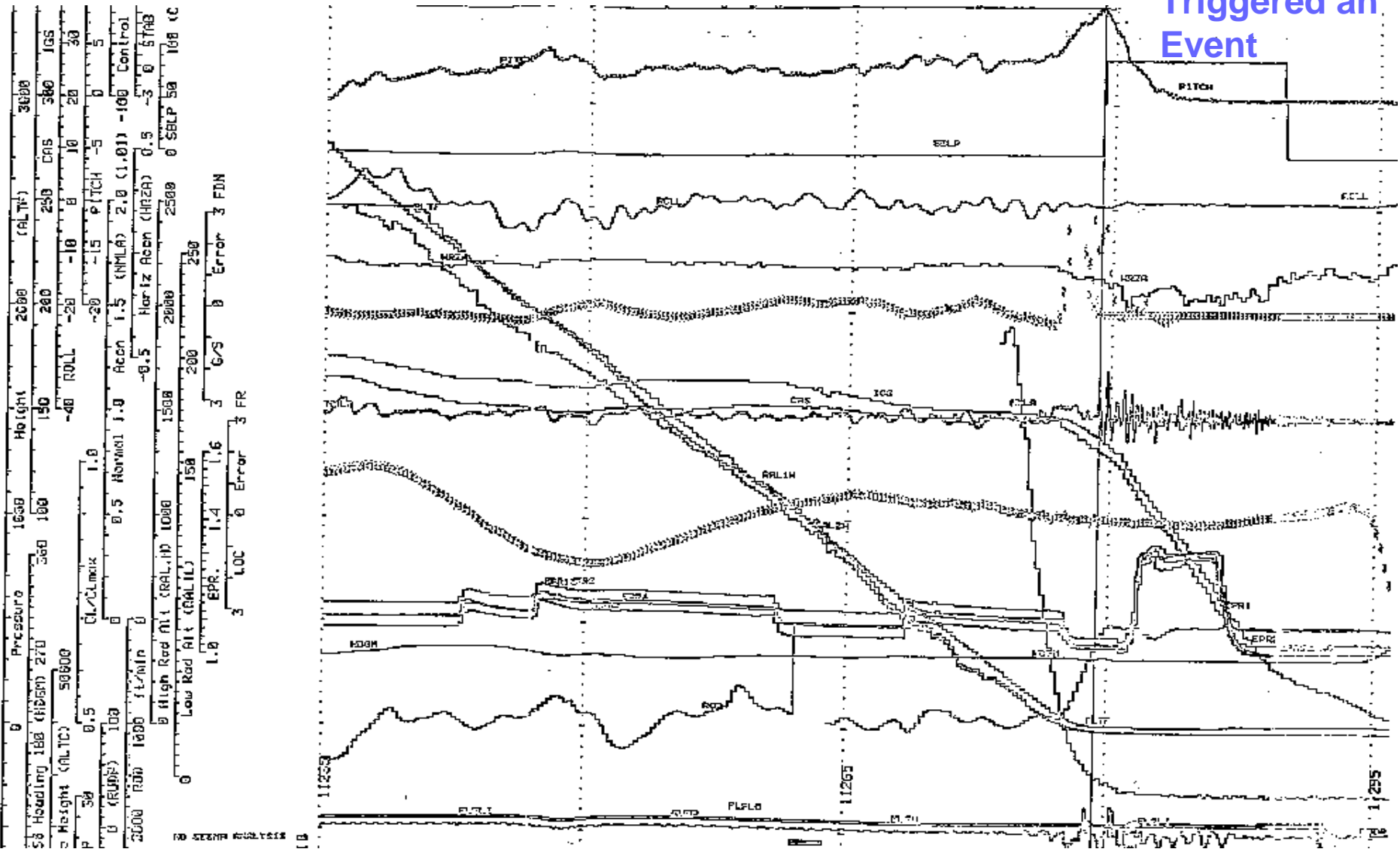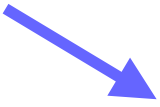# Flight Data Analysis Program

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

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

CAS

Altitude

ROD

Altitude (feet AAL) and ROD (fpm)

CAS (knots)

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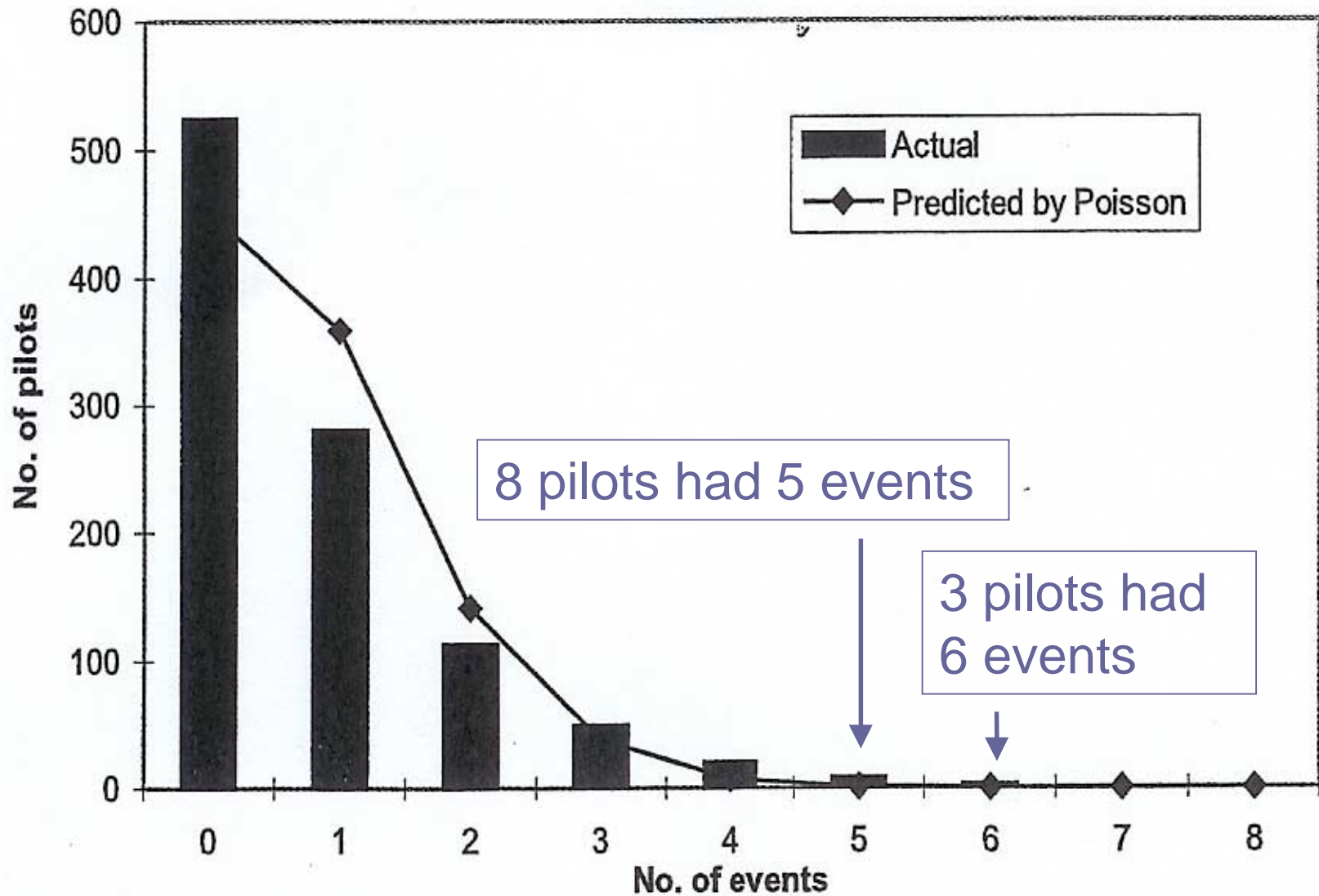
Figure 3: actual and predicted distribution of events amongst 747-400 pilots

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

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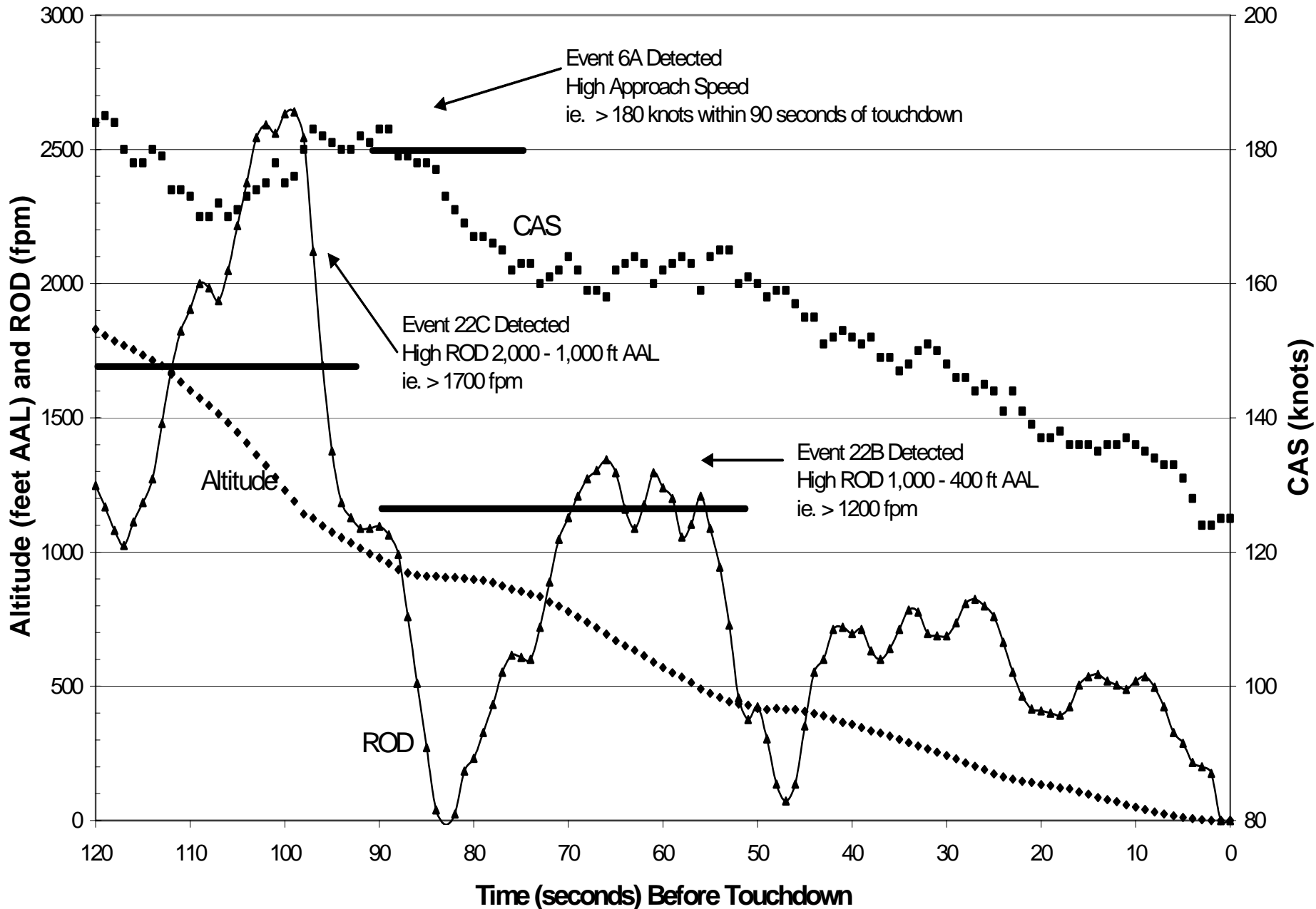
- On request provide direct feedback to crews

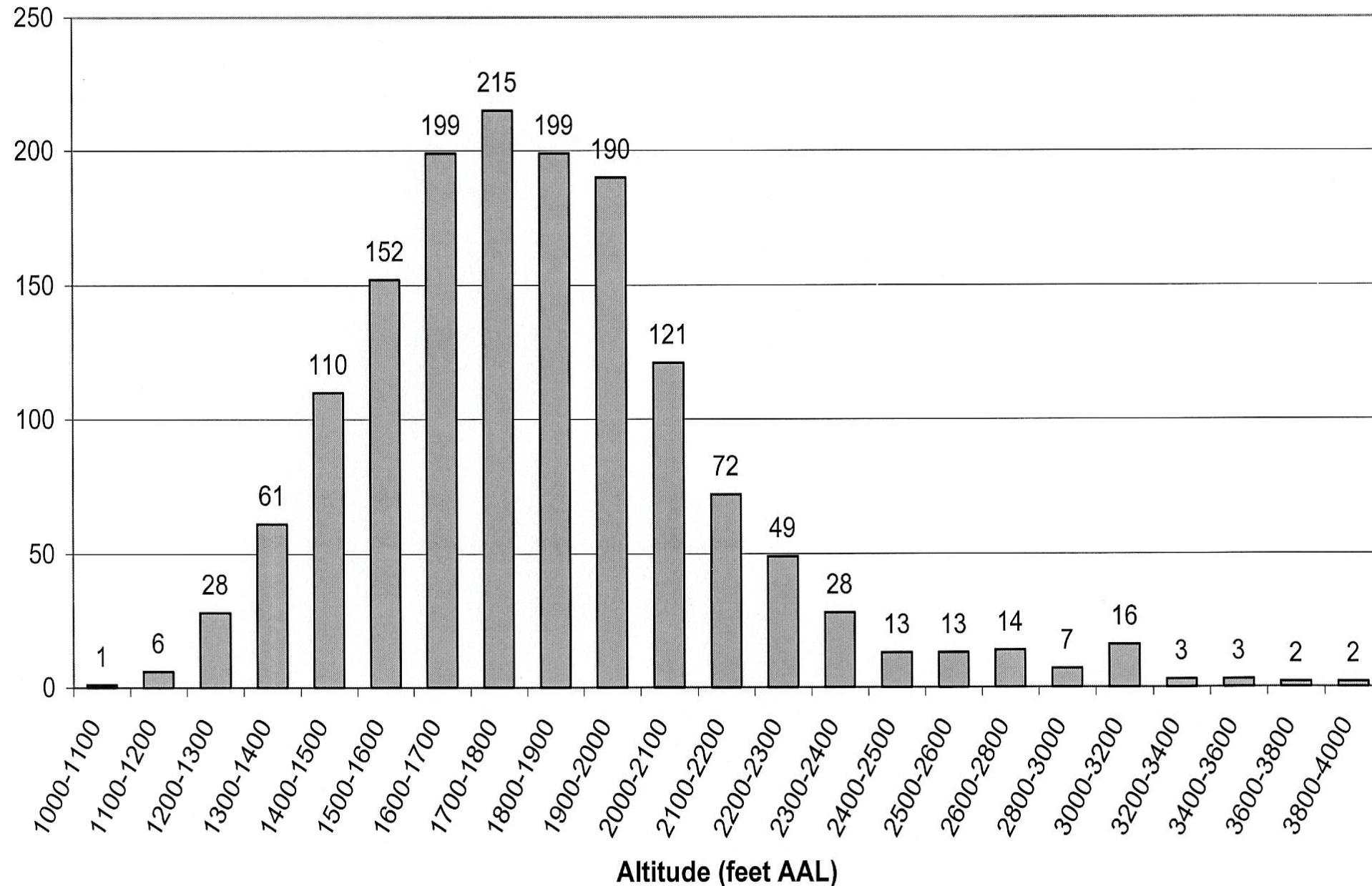# Altitude At Which Landing Flap Is Set

Bar chart showing the number of occurrences by altitude band (feet AAL):

Altitude (feet AAL)	Count
1000-1100	1
1100-1200	6
1200-1300	28
1300-1400	61
1400-1500	110
1500-1600	152
1600-1700	199
1700-1800	215
1800-1900	199
1900-2000	190
2000-2100	121
2100-2200	72
2200-2300	49
2300-2400	28
2400-2500	13
2500-2600	13
2600-2800	14
2800-3000	7
3000-3200	16
3200-3400	3
3400-3600	3
3600-3800	2
3800-4000	2

Altitude (feet AAL)

Altitude At Which Landing Flap Is Set

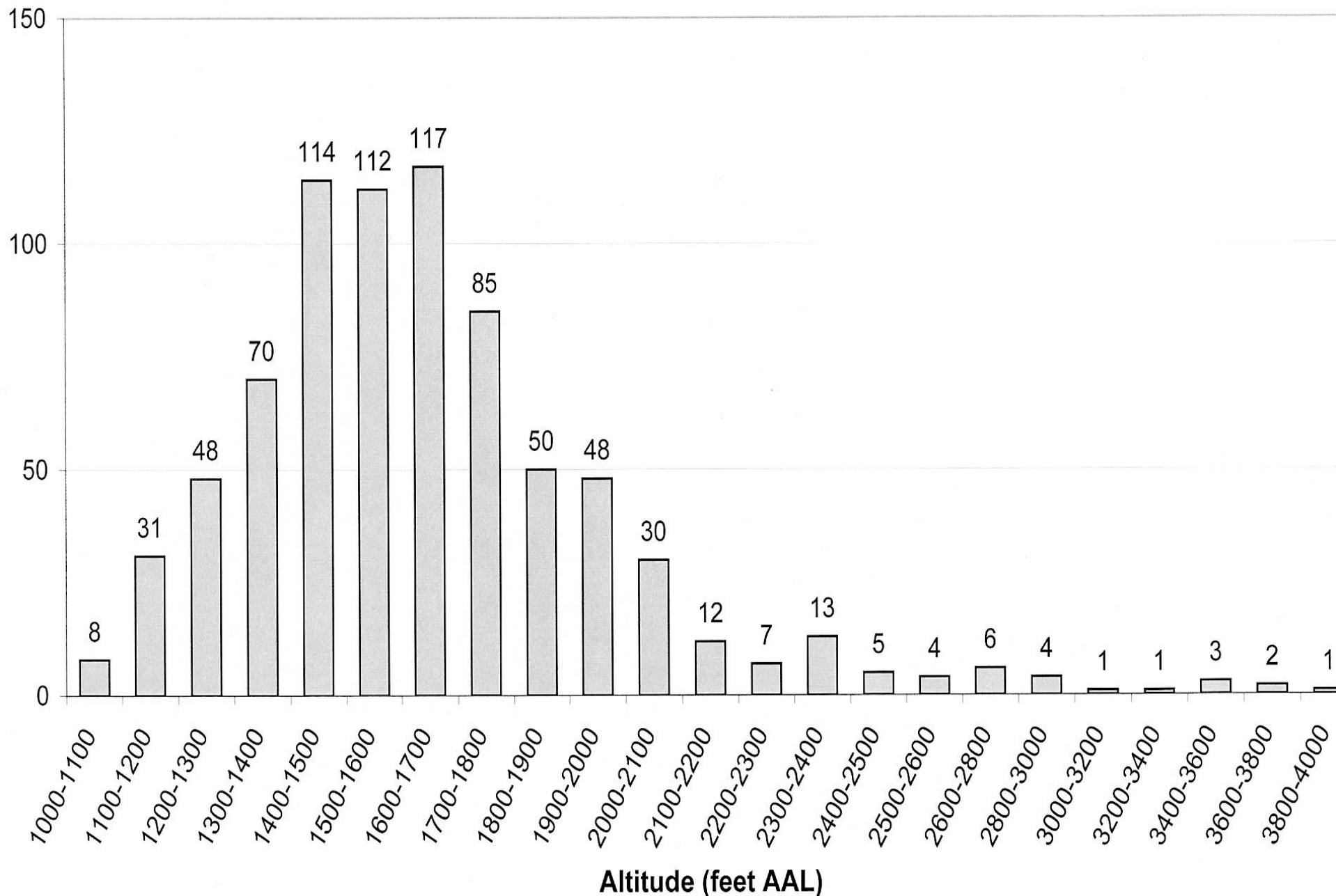| Altitude (feet AAL)	Count
1000-1100	8
1100-1200	31
1200-1300	48
1300-1400	70
1400-1500	114
1500-1600	112
1600-1700	117
1700-1800	85
1800-1900	50
1900-2000	48
2000-2100	30
2100-2200	12
2200-2300	7
2300-2400	13
2400-2500	5
2500-2600	4
2600-2800	6
2800-3000	4
3000-3200	1
3200-3400	1
3400-3600	3
3600-3800	2
3800-4000	1

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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

References:

1. *"Flight Data Analysis Program at Cathay Pacific Airways"*

    Airbus Flight Operations Monitoring & Safety Development Conference
    Hong Kong on March 12, 2002.

    Author: Neil Campbell
                Manager Air Safety
                Cathay Pacific Airways

2. *"British Airways' Flight Data Analysis Programme 1969 – 1999"*

    International Symposium on Transportation Recorders
    Arlington, Virginia USA during May 1999.

    Author: Captain Mike Holtom
                Senior Manager Safety Services
                British Airways

3. *"SESMA: Are Some Pilots More Equal Than Others?"*

    Author: Captain John Savage
                Flight Manager SESMA
                British Airways