The New Zealand Aviation Safety Management System

Civil Aviation Authority of New Zealand

Richard White
Manager Safety Investigation
Define Objectives

System Descriptions

Hazard Identification: Identify Hazards and Consequences

Risk Analysis: Analyze Hazards and Identify Risks

Risk Assessment: Consolidate and Prioritize Risks

Decision-Making: Develop an Action Plan

Validation of Control: Evaluate Results for Further Action

Modify System/Process

System Safety Process
CIVIL AVIATION AUTHORITY
POLYGON OF CERTAINTY
CIVIL AVIATION AUTHORITY
POLYGON OF UNCERTAINTY

- Poor Maintenance practices
- Risky operations
- Poor corporate culture
- Lack of training
- Bogus parts
- Risky operations

Accident

Risky

OK
Just Culture

• **Purposeful Behaviour** :- Behaviour carried out with the *intent* of causing an incident or injury, or to mislead the investigation.

• **Behaviour with knowledge of outcome** :- Behaviour where something has occurred (eg. an error) that the person is *aware* of, and which the person knows will (likely) lead to an incident, or mislead the investigation.

• **Behaviour under influence of drugs or alcohol** :- Any behaviour that leads to an incident where the behaviour follows the *intentional consumption* of alcohol or other drugs.

• **Reckless Behaviour** :- Behaviour carried out with *conscious disregard* that the behaviour will *significantly and unjustifiably increase the probability* of an incident occurring.

• **Negligent Behaviour** :- Situation where the person should have *known* that his/her behaviour would *significantly and unjustifiably increase the probability* of an incident occurring.

• **Multiple acts of Negligent Behaviour** :- Do the multiple acts indicate a *general lack of care and professionalism*?
AVIATION SAFETY
MANAGEMENT SYSTEM

A  S  M  S
Identification of this ‘gap’ assists in prioritising and focusing safety programmes.

Next Target: Continues to approach zero.

Targeted Level for year 2000:

Required Trend:

Actual Safety Performance:

Accidents per 100,000 Flight Hours

1996 2000
In Terms of the Polygon of Certainty

100% of Flight Time

Red behaviour
Orange behaviour
Green behaviour

Improvement over time reflects:
- Better compliance by industry with rules
- Rules improved by CAA
- Better safety knowledge of industry + CAA
CONTROL STEPS

1. Decide what is to be controlled
2. Select units to measure it with
3. Choose the desired target standard
4. Devise a way to carry out this measurement
5. Carry out the measurement
6. Compare the measured results to target standard, and
7. Take steps to adjust actual measured performance to target standard
SAFETY CONTROL LOOP

FAULT FOUND

CAUSES REMOVED

CORRECTIVE ACTION PLANNING

CAUSAL FACTORS ESTABLISHED
Proactive Surveillance

Auditing
Spot Checks
Enforcement
Audit Requirements

A series of modularised audit requirements can be loaded against each department, identifying what is required to audit that department. This includes the check lists required. Scheduling details such as the auditor skills, the estimated hours and the frequency of audit must also be specified. These details can then be used as the basis for scheduling and conducting the audit.
Audit Scheduling

Calendar based audit scheduling is used to review all audit modules (requirements) due to be audited in a specified period, based on the audit frequency and when that module was last carried out. From this list of requirements, an audit is created, specifying target start and end dates and a brief description.
The typical auditor is a man past middle age, spare, wrinkled, intelligent, cold, passive, non-committal, with eyes like codfish, polite in contact, but at the same time unresponsive, calm and as damnable composed as a concrete post or a plaster-of-paris cast; a human petrifaction with a heart of feldspar and without charm, minus bowels, passion or a sense of humour. Happily they never reproduce; and all of them finally go to Hell.
<table>
<thead>
<tr>
<th>Subject for Review</th>
<th>Comments</th>
<th>Confidence Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Financial/Labour/Management Difficulty</td>
<td>ANZ Auckland are up-to-date with payments to the CAA.</td>
<td>Confident</td>
</tr>
<tr>
<td>2. Change in Company Capability</td>
<td>Since Part 145 issue B737-300 added.</td>
<td>Very Confident</td>
</tr>
<tr>
<td>3. Change in Key Personnel</td>
<td>The Engineering Business Unit has recently been restructured.</td>
<td>Confident</td>
</tr>
<tr>
<td>4. Internal Audit Reports</td>
<td>The Internal Audit Reports have been sampled. These are to a high standard.</td>
<td>Very Confident</td>
</tr>
<tr>
<td>5. Occurrence Reports</td>
<td>Occurrence reports for 1993 are 57, most of which are minor in nature,</td>
<td>Very Confident</td>
</tr>
<tr>
<td>6. Honesty Weighting</td>
<td>Air New Zealand continue to deal with the CAA in an honest and professional manor.</td>
<td>Very Confident</td>
</tr>
<tr>
<td>7. Previous CAA Audit History</td>
<td>Part 145 compliance audit shows that Tech Services had most problems followed by component maintenance. The audit program for 1994 focussed on sampling plans</td>
<td>Very Confident</td>
</tr>
</tbody>
</table>
AUDIT HRS GRAPH

YEAR
ANSETT STAFF = 125

Extremely Confident x .4 = 50
Very Confident x .6 = 75
Confident x .9 = 112
Confidence not x 1.17 = 146
Yet Established
Audit Cause (Totals)

- ACTIONS INCONSISTENT WITH PROCEDURE: 0
- OTHER ORGANISATION FACTS: 0.5
- POOR INSTRUCTIONS/PROCEDURE: 1
- INADEQUATE CHECKING: 1.5
- INADEQUATE COMMUNICATION: 2
- INADEQUATE CONTROL AND MONITORING: 2.5
- INADEQUATE PLANNING: 1
- INADEQUATE RESOURCE MANAGEMENT: 0
# Risk Profile

**03-Dec-2002**  
**41508**  
**Air Adventures New Zealand Limited**

**Reason for profile**  
Request from within the CAA - Strong56

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Assessment</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator Profile</td>
<td>4</td>
<td>Has non-145 maintenance provider (10786), unsched pax, est &gt; 12 mths.</td>
</tr>
<tr>
<td>Operator Management</td>
<td>9</td>
<td>Two ppl each hold 2 or more positions: J Williams is CI, QA &amp; Maint., M Barnsman is Ops &amp; Trg.</td>
</tr>
<tr>
<td>Management Stability</td>
<td>0</td>
<td>No recent changes.</td>
</tr>
<tr>
<td>Operational Stability</td>
<td>2</td>
<td>Added NCA - PA31, type previously operated.</td>
</tr>
<tr>
<td>Occurrence Evaluation</td>
<td>0</td>
<td>Nothing remarkable. Stats 3q01-2q02: 555 hrs, 2 occ's, 1-2 expected gives 82.1%. 0 occ since 17/2/2002.</td>
</tr>
<tr>
<td>Financial Status</td>
<td>4</td>
<td>Bad debtor once in last year - 402 for $2792.</td>
</tr>
<tr>
<td>Conditions Imposed</td>
<td></td>
<td>Not used as from 1/4/00</td>
</tr>
<tr>
<td>Last Audit Quality Evaluation</td>
<td></td>
<td>None in the 1st year.</td>
</tr>
<tr>
<td>Non-compliance Evaluation</td>
<td>4</td>
<td>Moderate NCI of 60 from 1 major, 1 minor non-compliances and 5 hrs audit in last year.</td>
</tr>
</tbody>
</table>

**Actual Profile Score:** 23  
**Possible Profile Score:** 76.00  
**Profile Percent Score:** 32.86 %  
**Profile Level:** Moderate

---

**Profile History for the 12 months prior to this profile**

- **06-May-2002**  
  **Change in Credit Status with the CAA**  
  **38.57 %**
Reactive Surveillance

Mandatory Occurrence Reporting (MOR) and Safety Investigation
Legislative Requirements

- Civil Aviation Act - Section 26
  - Establishes general requirement to report accidents and incidents

- Civil Aviation Act - Section 72B
  - Functions of the Authority
  - To investigate and review civil aviation accidents and incidents in its capacity as the responsible safety and security authority, subject to the limitations set out in section 14(3) of The Transport Accident Investigation Commission Act 1990

- Rule Part 12
  - Identifies what must be reported, by who, and when

- Advisory Circular to Rule Part 12
  - Defines an acceptable means of compliance
Initial Notification of Accidents

Rule Part 12 requires that a notification to the Authority is required of an accident and lists the information required.
Investigative Process

Notification
- Accidents and serious incidents
  : as soon as practicable

Provision of details
- Accidents, serious incidents and all other incidents
  : within 10 days of the occurrence

Investigation
- by CAA and / or by operator of own occurrences

Reporting
- by operator of own occurrences
  : within 90 days

Recording of information
- on the CAA database
CAA requirements (our needs)

- Data - Covering the reporting requirements of Rule Part 12 in a form that we can use at minimum cost, both to us, and to you the industry. To minimise our data entry costs we need to have it:
  - If on paper either
    - on our own form, or
    - one with substantially the same layout, or
    - as computer reports set out along the lines of our form
  - If electronically
    - In a format that matches our computer system’s data requirements.
- Reports - That give us confidence that the operator not only recognises the occurrence of a reportable safety event but responds to that event by conducting an appropriate investigation which identifies the cause/s and corrective actions necessary to prevent recurrence… and implements those corrective actions.
Investigation Requirements

Holders of certain aviation documents (the requirement is identified in the appropriate operating Rule) are required to investigate incidents which they have reported and submit their findings to the Authority. This provision will ensure that organisations will take timely corrective action when such a need is identified in the course of their investigations. The Authority, on receiving investigation reports, will assess if any further preventative and corrective action is required.

The investigation requirement placed on these holders of aviation documents does not derogate or replace the statutory responsibilities of TAIC or the Authority with respect to the investigation of incidents.
Notification Channels

- CAA 005 Form.
- AFTN Message.
- Fax.
- Phone.
- Letters and Email in some circumstances.
- Electronic Data Interchange (EDI) - AQD. systems at client sites (About 10 Aviation Quality Database (AQD) sites currently in New Zealand).
ICAO Reports

Annex 13 Report
Annex 8 Report
Aviation Quality Database - (AQD)

- Written by Superstructure Development Ltd.
- The system is based on the same design concepts as the CAA Systems and has been written to be compatible with these systems.
- The system is seen as a valued tool to assist in safety in that it is selling internationally as well as nationally.
Notification Capture:- Pre Add Check

Check for Existing Occurrence

Occurrence Date: 10/07/98 From: 9/07/98 To: 11/07/98

<table>
<thead>
<tr>
<th>Occ No</th>
<th>Type</th>
<th>Occ Date (UTC)</th>
<th>Location</th>
<th>Call Sign</th>
<th>Reg</th>
<th>Fac ID</th>
<th>AS ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>98/2046</td>
<td>DEF</td>
<td>09/07/98 00:00</td>
<td>AKL</td>
<td>NZ52</td>
<td>NZW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2009</td>
<td>BRD</td>
<td>09/07/98 00:13</td>
<td>OHAKEA</td>
<td>NZ6471</td>
<td>NBC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2047</td>
<td>INC</td>
<td>09/07/98 02:50</td>
<td>CHC</td>
<td>NZ192</td>
<td>SUI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/1864</td>
<td>ASP</td>
<td>09/07/98 06:00</td>
<td>Between HK &amp; NS</td>
<td>EwD</td>
<td>/K/I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/1929</td>
<td>ASP</td>
<td>09/07/98 07:05</td>
<td>LISMORE reporting</td>
<td>VAL62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2048</td>
<td>INC</td>
<td>09/07/98 07:55</td>
<td>SYD</td>
<td>NZ14</td>
<td>SUI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2010</td>
<td>BRD</td>
<td>09/07/98 08:14</td>
<td>WHENU APAI</td>
<td>N244SW</td>
<td>N2M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2049</td>
<td>DEF</td>
<td>09/07/98 11:00</td>
<td>Christchurch Interna</td>
<td>NZM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/1990</td>
<td>ARC</td>
<td>09/07/98 12:00</td>
<td>AUCKLAND</td>
<td>NZA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2014</td>
<td>BRD</td>
<td>09/07/98 15:22</td>
<td>GISBORN</td>
<td>NSX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2011</td>
<td>BRD</td>
<td>09/07/98 20:33</td>
<td>PALMERSTON NORTH</td>
<td>JSA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2012</td>
<td>BRD</td>
<td>09/07/98 22:45</td>
<td>INVERCARGILL</td>
<td>MCS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2062</td>
<td>DGD</td>
<td>10/07/98 00:00</td>
<td>AUCKLAND</td>
<td>NZA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/2013</td>
<td>BRD</td>
<td>10/07/98 00:30</td>
<td>TAIPU</td>
<td>NZA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/1865</td>
<td>ACC</td>
<td>10/07/98 01:40</td>
<td>WHITCOMBE PASS</td>
<td>NZM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>98/1910</td>
<td>ASP</td>
<td>10/07/98 05:40</td>
<td>NELSON</td>
<td>RLK521</td>
<td>K1/UTA/C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date Time: 09/07/98 00:00:00
Location: AKL
Aircraft: Boeing 747-219B
UTC: 9807900000
Description: A lighting struck galley 2/3. Just after this the stick shaker activated. F/O (First Officer) then flew manually. F/E (First Engineer) pulled C/B's (Circuit Breakers) eliminating system 1, and isolating system 2 as faulty C/B pushed in later in climb, stick shaker activated once again C/B left out.

Descriptor | Item Text
--- | ---
Nature of flight | TRANSPORT PASSENGER A TO B
Flight Phase | CLIMB
Effect on flight | NIL
Operational Incident | Lightning Strike
Defect Subjects (ATA10) Stall Warning System |
Accident Report

Accident Incident Report

Occurrence Date Time: 05/01/1997 08:03:01

Aircraft manufacturer model: GAF N24A
Operator ID: 40056 - Nationwide Helicopters Ltd
Location: WOODEBOURNE

Target Accident Rate - 12 Month Moving Average

Accidents per 100,000 Flying Hours

The aircraft was on approach to runway 16 at Wellington airport. When the crew selected the landing gear down there was no response from the system. As no sound or movement had been observed the pilot checked the circuit breakers and found the gear actuator breakers had opened and would not reset. The crew carried out an overshoot and held clear of the circuit pattern.
• This example used the “Accident Incident” form. If this was an airspace occurrence then the Airspace form would have been used.

• The forms are shared between registration and investigation processes.

• The yellowing of fields indicate the required fields for the occurrence type.

• The initial switch board form used by the investigators has additional buttons giving access to Findings, Cause, Actions (FCAs) and the entry of an occurrence synopsis.
Occurrence Type

- ACC - Accident
- ARC - Aviation Related Concern
- ASP - Airspace Incident
- BRD - Bird Incident
- DEF - Defect Incident (SDR)
- DGD - Dangerous Goods Incident
- INC - Aircraft Incident
- NIO - Navigation Installation Occurrence
- PIO - Promulgated Information Occurrence
Initial Processing of EDI Reports

Specification published on CAA’s WEB site.
The interface

• Developed in partnership with Superstructure Development Limited to facilitate the sending of Occurrence Reports, FCAs and Client Safety Investigation Report from AQD to the CAA’s systems.

• The information is sent as email over the internet and automatically processed into tables in the corporate database.
• The information is retained as a record of the clients view of the occurrence and their actions to prevent re-occurrence pursuant with Rule Part 12.

• The new items in this list are reviewed daily by the occurrence registration function either linking the report occurrence to an existing recorded occurrence in the CAA System or raising a new occurrence in the CAA system.

• Report - Rule Part 12

• Record and track - Quality System - required by Rule Part Part 119.
Process Occurrence

Accident Rate - 12 Month Moving Average

Target 25.0

Accidents per 100,000 Flying Hours

95/1 95/3 96/1 96/3 97/1 97/3 98/1 98/3 99/1 99/3 2000
Findings
AQLD New List

Accident Rate - Five Year Moving Average

Target

94/1 94/3 95/1 95/3 96/1 96/3 97/1 97/3 98/1 98/3 99/1 99/3 2000

Accidents per 100,000 Flying Hours
Findings, Causes and Actions

• Finding: - The problem that has been discovered.


• Action: - An action that needs to be implemented to address or partly address a cause.
Entity Relationship Diagram
Cause Coding

• Basically three elements:
  – Person/Organisation
  – Cause Category
    • Active Failure
    • Local Violation
    • Local Error
    • Organisation Failure
  – Cause Descriptor

• Local violation, local error and organisation failure are all latent failures working back into the organisation.
<table>
<thead>
<tr>
<th>Hold</th>
<th>WR</th>
<th>Target</th>
<th>Occurrence</th>
<th>Severity</th>
<th>Type</th>
<th>Date Time</th>
<th>Location</th>
<th>Call</th>
<th>Mark</th>
<th>WR State</th>
<th>WR Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>✗</td>
<td>5/SAI/326</td>
<td>1/12/2004</td>
<td>04/2760</td>
<td>MA</td>
<td>DEF</td>
<td>19/07/2004</td>
<td>Wanganui</td>
<td>EUH</td>
<td>Closed</td>
<td>EUH-Aileron Cable</td>
<td></td>
</tr>
</tbody>
</table>

### Descriptors
- **Descriptor**: Flight Phase
- **Item Text**: PARKED
- **Descriptor**: Defect Subjects [A1]
- **Item Text**: AEROPLANE FLIGHT CONTROL - GEN

### Involved Clients
- **Client**: 10407
- **Role**: Pilot
- **Client**: 12706
- **Role**: MaintOrg
- **Client**: 12706
- **Role**: Operator

### Assigned Staff
- **Staff Member**: Stobbal
- **Staff Role**: Investigator

### Details
- **Date**: 19/07/2004 00:00
- **Location**: Wanganui
- **Severity**: MA
- **Description**: Wanganui Aero Work reported that the aircraft’s direct aileron cables were found badly worn. New aileron cables fitted.
### Finding Description

During the 4 year inspection of ZK-EUH being carried out by Wanganui Aero Work both direct aileron cables were found badly worn with one near failure. The aircraft is relatively new to the fleet of Wanganui Aero Work.

### Cause Description

1. Poor alignment of aileron cable fairleads during manufacture or repair.

### Person Organisation

1211 AIRCRAFT OPERATOR - GENER

### Category

Active Failure

### Cause Item Text

1360 PRIMARILY "STRUCTURAL/MECHANICAL"

### Action Status

- Open
- Closed
- Cancelled
- Recheck

### Action Type

- Corrective
- Preventative
- Recommendation

Recommend urgently issue an AD similar to AD DCA/CRESO/6
Identifying Causes

The Civil Aviation Authority has used the work of Prof James Reason and Dr David O’Hare, as the basis for determining the causes of accidents, incidents, defects and other occurrences, taking organisational and human factors into account.

To enable these to be recorded in a fashion which can be analysed by the computer, the causes have been codified. The NZ CAA has given Superstructure approval to implement these codes within the Aviation Quality Database system.

When recording the causes, the “codes” are selected via drop down lists, as shown below:

The following slides show the James Reason Model, and David O’Hare’s method for determining active failures, both of which have been used as the basis for determining the codes used to classify the causal factors.
Decision-Makers
Fallible

Line Management
Deficiencies

Preconditions
Psychological Procursors of Unsafe Acts

Productive Activities
Unsafe Acts

Defences
inadequate

Limited Window of Accident Opportunity

Active & Latent Failures

Active Failures

Latent Failures

Latent Failures

Latent Failures

Limited Window of Accident Opportunity

Defences
inadequate

Active & Latent Failures

Active Failures

Latent Failures

Latent Failures

Latent Failures

Limited Window of Accident Opportunity

Defences
inadequate

Active & Latent Failures

Active Failures

Latent Failures

Latent Failures

Latent Failures

Limited Window of Accident Opportunity
Organisation

Organisational Factors
For example:
Communications
Management
Structure
Goals

Local Error or Violation Factors
For example:
Morale
Fatigue
Equipment
Procedures

Active Failures
Eg Errors;
Information
Diagnostic
Goal
Strategy...

Latent Failures
For example
Structural/Mechanical/Other

Components

AND/OR

Accident

ORGANISATION

TASK/ENVIRONMENT

INDIVIDUAL

DEFENCES
ORGANISATION FAILURE ITEMS

- Inappropriate Goals or Policies
- Organisation Structural Deficiencies
- Inadequate Communications
- Poor Planning
- Inadequate Control and Monitoring
- Design System Deficiencies
- Inadequate Defences
- Unsuitable Materials
- Unsuitable Equipment
- Poor Procedures
- Poor Training
- Poor Coordination
- Inadequate Regulation
- Other Organisation Factor
ERROR ITEMS

- Task Unfamiliarity
- Time Shortage
- Poor Signal: Noise
- Poor Human-System Interface
- Designer User Mismatch
- Irreversibility
- Information Overload
- Negative Task Transfer (Habits)
- Task Overload
- Risk Misperception
- Poor System Feedback
- Inexperience (Not Lack of Training)
- Lack of Knowledge
- Task/Education Mismatch
- Poor Instructions/Procedures
- Inadequate Checking
- Hostile Environment
- Other Environmental Factor (e.g. Weather)
- Interpretation difficulties
- Disturbed Sleep Patterns
- Fatigue - Other
- Drugs/Alcohol
- Visual Illusion
- Disorientation/Vertigo
- Physiological Other
- Monotony/Boredom
- Lack of Confidence
- Poor Attention Span
- Psychological Other
- Other Error Enforcing Condition
VIOLATION ITEMS

- Lack of Safety Culture
- Management/Staff Conflict
- Poor Morale
- Poor Supervision & Checking
- Group Violation Condoning Attitude
- Hazard Misperception
- Lack of Management Care/Concern
- Lack of Pride in Work
- Risk Taking Culture Encouraged
- Complacency (i.e., It Can’t Happen)
- Learned Helplessness (i.e., Who Cares)
- Perceived License to Bend Rules
- Age/Sex Factor
- Other Violation Enforcing Condition
Active Failure Classification

Was there an opportunity for human intervention?  
Yes \rightarrow Structural/Mechanical

Did the person detect cues arising from the change in the system state?  
Yes \rightarrow Information Error

On the basis of the information available, did the person diagnose accurately the state of the system?  
Yes \rightarrow Diagnostic Error

Did the person choose a goal which was reasonable in the circumstances?  
Yes \rightarrow Goal Error

Did the person choose a strategy which would achieve the goal intended?  
Yes \rightarrow Strategy Error

Did the person execute procedures consistent with the strategy intended?  
Yes \rightarrow Procedure Error

Was the procedure executed as intended?  
Yes \rightarrow Action Error

No \rightarrow Diagnostic Error

No \rightarrow Goal Error

No \rightarrow Strategy Error

No \rightarrow Procedure Error

No \rightarrow Action Error

The values shown in the green boxes are the codes loaded into the AQS system for active failures.
Analysis Tools

The analysis tools allow you to select the data to be analysed, and the method by which you want the output to be presented. The data is extracted and passed to Microsoft Excel to produce the appropriate graph. The tools within Excel can then be used, if desired, to alter the appearance of the graph and to apply trend lines.

You go from this:
Analysis Tools contd.

Top 10 Causes By Person/Org

- Time shortage
- Risk misperception
- Procedures not followed
- Primarily "structural/mechanical"
- Poor attention span
- Interpretation difficulties
- Inadequate specifications/requirements
- Inadequate control and monitoring
- Inadequate checking
- Design system deficiencies

Maintenance organisation
Manufacturer
Pilot-in-command
Staff
Unit Mgmt/supervisory
### RULE RATE

<table>
<thead>
<tr>
<th>Month</th>
<th>Rule Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>0.6</td>
</tr>
<tr>
<td>F</td>
<td>0.5</td>
</tr>
<tr>
<td>M</td>
<td>0.7</td>
</tr>
<tr>
<td>A</td>
<td>0.7</td>
</tr>
<tr>
<td>M</td>
<td>0.8</td>
</tr>
<tr>
<td>J</td>
<td>0.9</td>
</tr>
<tr>
<td>J</td>
<td>1.0</td>
</tr>
</tbody>
</table>

### OCCURRENCE RATE

<table>
<thead>
<tr>
<th>Month</th>
<th>Occurrence Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>50</td>
</tr>
<tr>
<td>F</td>
<td>30</td>
</tr>
<tr>
<td>M</td>
<td>70</td>
</tr>
<tr>
<td>A</td>
<td>60</td>
</tr>
<tr>
<td>M</td>
<td>80</td>
</tr>
<tr>
<td>J</td>
<td>90</td>
</tr>
<tr>
<td>J</td>
<td>100</td>
</tr>
</tbody>
</table>

### CORRELATION

<table>
<thead>
<tr>
<th>Rule Parts or Causal Factors of Approval Types</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule Rate</td>
<td>0.5</td>
</tr>
<tr>
<td>Occurrence Rate</td>
<td>0.7</td>
</tr>
<tr>
<td>Correlation</td>
<td>0.8</td>
</tr>
</tbody>
</table>

---

#### RULE EVENT MONITORING TABLE

**a)** IF \[ \frac{\sum (NCP + NCF) \text{ JUN/145.10}}{\sum \text{(TIMES TESTED) JUN/145.10}} > y \text{ 145.10} \] THEN ALERT

**b)** IF \[ \left\{ \frac{\sum (NCP + NCF) \text{ JUN/145 - } j}{\sum \text{(TIMES TESTED) JUN/145 - } j} \right\} > z \text{ 145} \] THEN ALERT
Organisational and managerial factors

- Organisational structure
- Commercial & operational pressures
- Safety mgt.
- Maintenance mgt.
- Operational mgt.
- Crew factors

Cause for concern

Priority factors

Reforms
Below 2,721 kg - Revenue Pax & Freight

Accident Rate - 12 Month Moving Average

Accidents per 100,000 Flying Hours

Target 2.5

95/1 95/3 96/1 96/3 97/1 97/3 98/1 98/3 99/1 99/3 2000
Audit 98-2004 NCP, NCF, OBS and SRC Trend
Analysis Tools contd.

Once the graphs are in Excel, trend lines can be applied using the standard Excel regression analysis tools. The graph below shows a linear trend line applied to the number of bird strikes.
Effective incident reporting programme
What we are seeing

Accidents

Critical Incidents

Major Incidents

Minor Incidents

What we think exists but is not being reported
DEFECT CRITICALITY TREND

Critical
Major
Minor
Not Classified
Ineffective incident reporting
Airspace incident rate per 1000 hours flown

Year


Pilot caused
Controller caused
### Dominant factors for pilot caused airspace incidents.

<table>
<thead>
<tr>
<th>INCIDENT</th>
<th>DOMINANT FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Active</td>
</tr>
<tr>
<td>Unauthorized Airspace Incursion</td>
<td>Actions inconsistent with procedures, i.e. execution errors.</td>
</tr>
<tr>
<td>Unauthorized Altitude penetration</td>
<td>Actions inconsistent with procedures, i.e. execution errors.</td>
</tr>
<tr>
<td>Near Collision</td>
<td>Diagnosis, Procedural and actions inconsistent with procedures, i.e. execution errors almost equal.</td>
</tr>
<tr>
<td>Pilot Position Reporting Deficiency</td>
<td>Not Enough Data</td>
</tr>
<tr>
<td>Breach of Other Clearance</td>
<td>Inaccurate system diagnosis, i.e. diagnostic errors.</td>
</tr>
<tr>
<td>Flight Assist</td>
<td>Not Enough Data</td>
</tr>
<tr>
<td>Pilot Flight Planning Deficiency</td>
<td>Not Enough Data</td>
</tr>
</tbody>
</table>
## Dominant factors for controller caused airspace incidents.

<table>
<thead>
<tr>
<th>INCIDENT</th>
<th>DOMINANT FACTORS</th>
<th>INCIDENT</th>
<th>DOMINANT FACTORS</th>
<th>INCIDENT</th>
<th>DOMINANT FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of separation</td>
<td>Actions inconsistent with procedures, i.e. execution errors.</td>
<td>Active</td>
<td>High controller workload factors and poor concentration/ lack of attention factors.</td>
<td>Local</td>
<td>Inadequate control and monitoring, inadequate specifications or requirements.</td>
</tr>
<tr>
<td>ATS Coordination Deficiency</td>
<td>Actions inconsistent with procedures, i.e. execution errors.</td>
<td>Active</td>
<td>Poor instructions and procedures and poor concentration/ lack of attention factors</td>
<td>Local</td>
<td>Design system deficiencies and inadequate specifications or requirements.</td>
</tr>
<tr>
<td>Near Collision</td>
<td>Diagnosis, Procedural and actions inconsistent with procedures, i.e. execution errors almost equal.</td>
<td>Local</td>
<td>Psychological factors.</td>
<td>Organisation</td>
<td>Poor resource management and inadequate defences.</td>
</tr>
<tr>
<td>ATS Clearance/ Instruction Deficiency</td>
<td>Actions inconsistent with procedures, i.e. execution errors.</td>
<td>Active</td>
<td>Inadequate checking and poor concentration/ lack of attention.</td>
<td>Local</td>
<td>Poor resource management and inadequate control and monitoring.</td>
</tr>
<tr>
<td>ATS Flight Planning System Deficiency</td>
<td>Actions inconsistent with procedures, i.e. execution errors.</td>
<td>Active</td>
<td>Inadequate checking and poor concentration/ lack of attention.</td>
<td>Local</td>
<td>Design system deficiencies and inadequate specifications or requirements.</td>
</tr>
<tr>
<td>ATS Flight Information Deficiency</td>
<td>Inaccurate system &quot;diagnosis&quot; errors.</td>
<td>Active</td>
<td>Inadequate checking and poor concentration/ lack of attention.</td>
<td>Local</td>
<td>Poor procedures and inadequate control and monitoring.</td>
</tr>
</tbody>
</table>
Occurrence Rate Comparison by Operator

The graph compares the occurrence rate per 100,000 hours for different operators. Each operator is represented by a different color: blue for ASP, red for DEF, and yellow for INC.

- Operator B has the highest occurrence rate among ASP and DEF, but lower than INC.
- Operator C has a moderate occurrence rate across all categories.
- Operator D has a significantly lower occurrence rate than other operators.
- Operator E has a high occurrence rate, predominantly for DEF.
- Operator F has a high occurrence rate, predominantly for ASP.
- Operator G has a noticeable occurrence rate, primarily for DEF.
- Operator I has a moderate occurrence rate, with ASP and DEF being higher than INC.
- Operator K has a moderate occurrence rate, with ASP and INC being higher than DEF.
- Operator L has a high occurrence rate, with a significant contribution from INC.
- Operator N has a high occurrence rate, primarily for DEF.
- Operator O has a moderate occurrence rate, with ASP being higher than DEF and INC.

The graph provides a clear visual representation of the occurrence rates across different operators and categories.
Management and staff attitude towards safety;
Clarity of quality management system;
Documentation;
Facility suitability & upkeep;
Tools/equipment/materials;
Adherence to standards and specifications;
Personnel skills, knowledge and numbers;
Control/management system effectiveness;
Corrective and preventive actions; and
Auditor assessment.
CAA Enforcement Unit

• Outside of Part 12 reporting, the CAA Enforcement unit receives about 200 to 250 complaints a year most of which come from members of the public and other operators operating within the rules who are being disadvantaged by those who are not. From 1 July 2000 to 30 June 2001 184 alleged offences were reported outside of Part 12, 136 enforcement investigations were carried out. 53 enforcement actions were taken of which 51 (96%) were successful.

• This is outside of and separate from the 4000+ of safety failures reported under Part 12.
Barriers to reporting by industry: “Fear of prosecution”

• Information on incidents reported to the CAA’s Safety Investigation Unit may not be used or made available for the purpose of an investigation to establish whether an offence has been committed, or for prosecution action, unless:
  – the information reveals an act or omission that caused unnecessary danger to any other person or to any property;
  – or false information is submitted.
  – The CAA will not release the information gathered under Part 12 to any other person, unless a statutory requirement exists so ordered by the courts.
Examples of unnecessary danger

- Pilot operating a helicopter at an unnecessarily low altitude carrying out an unnecessary 45 degree banked turn resulting in a collision with the ground. One of the two passengers, who were both seriously injured, was not provided with a proper safety harness.

- The logbook entries relating to a set of tail rotor blades were altered to conceal the history to enable the engineer to refit them whilst actually time expired.

- A person knowingly allowed illegal repairs to be carried out to tail rotor blades and intentionally did not pass this information on to the engineer that installed the blades and certified for the installation. These illegal repairs caused the blades to disintegrate in flight resulting in the deaths of the pilot and crew member.

- The overseas engineers carried out a repair to a damaged main rotor blade. The repair was not in accordance with the manufacturers repair limits and was hidden with filler. The main rotor blade cracked in service potentially leading to total blade failure.
Causal Factor Analysis - The AQD Process

Occurrence

Active Failures

Report

Routine Audit

Investigation

Finding

Finding

Finding

Cause

Cause

Cause

Action

Action

Action

Search for Latent Conditions

Effect Analysis What Why Prevention
“Data without a theory is like a body without a skeleton.
All you can do is carry it around in a bucket.”
The New Zealand Aviation Safety Management System

Civil Aviation Authority of New Zealand

Richard White
Manager Safety Investigation