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Threat and Error Management: An Analysis of Reported Safety Occurrences to the Civil Aviation Authority of New Zealand 1998–2007

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Abstract

Current safety reports indicate a rise in the number of reported incidents involving both medium and small aeroplanes and helicopters. The purpose of this study is to identify specific threats, errors and Undesirable Aircraft States (UAS), present in safety-related occurrences reported to the Civil Aviation Authority of New Zealand (CAANZ).

Threat and Error Management (TEM) is used to improve safety margins in aviation operations through the practical integration of human factors knowledge. The TEM framework is used to guide the investigation of reported safety-related occurrences in a way that systematically identifies specific threats, errors and UAS.

This research employs the predictive safety method by investigating reported historical events, followed by analysing each event to list threats, errors and UAS. If a threat, error or UAS is identified in an occurrence, it is then marked ‘present’ under the corresponding column of the TEM taxonomic. After the completion of the classifications, solutions can be developed to prevent similar occurrences in the future.

To test for accuracy and consistency of threat, error and UAS classifications, ten randomly chosen occurrences were provided to ten aviation professionals. These tests included Cohen’s Kappa test and a percentage of agreement test. Cohen’s Kappa results reached significant agreement with half of the respondents and an overall percentage of agreement of 68 per cent compared with the researcher’s classifications.

Results from the TEM classifications show the majority of threats had environmental influences and procedural errors. The most common UAS resulted mainly from Ground Navigation and Aircraft Handling operational conditions.

The TEM technique enabled a focus on the events that contributed to an incident rather than an accident. By applying the results from this TEM taxonomic, it is hoped
that pilots will benefit from a better understanding of the importance of TEM and how frequently threat and errors contribute to incidents. This research would then help flight operators and pilots better prepare themselves to react to the likelihood of specific threats or errors, if and when they occur.
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Table of Contents

Abstract .............................................................................................................................. ii
Acknowledgements .......................................................................................................... iv
Table of Contents ............................................................................................................... v
List of Tables ...................................................................................................................... ix
Glossary ............................................................................................................................. x

1.0 Introduction ................................................................................................................ 1

2.0 Literature Review ...................................................................................................... 3
  2.1 Aviation Safety ......................................................................................................... 3
  2.2 Accidents and Incidents ......................................................................................... 5
  2.3 Human Error Models ............................................................................................ 6
  2.4 Human Factors Analysis and Classification System .............................................. 9
  2.5 Crew Resource Management ............................................................................ 17
  2.6 Flight Performance Assessment ........................................................................ 18
  2.7 Personal Pilot Mail-out Studies .......................................................................... 21
  2.8 Pilot Involvement in Hazardous Events .............................................................. 25
  2.9 Threat and Error Management .......................................................................... 26
  2.10 Incident Reporting Systems ............................................................................ 28
  2.11 The CAANZ Safety Reporting System .............................................................. 30

3.0 Research Methodology and Data ............................................................................ 32
  3.1 Research Focus ..................................................................................................... 33
  3.2 The CAANZ Database ......................................................................................... 34
  3.3 Data Processing .................................................................................................... 36
    3.3.1 Data Analysis ................................................................................................. 37
    3.3.2 Data Classification Examples ...................................................................... 40

4.0 Results and Discussion ............................................................................................ 42
  4.1 Classification Consistency Results ....................................................................... 43
    4.1.1 Classification Reliability ............................................................................... 45
    4.1.2 Classification Consistency Checks ............................................................... 46
  4.2 Threats ................................................................................................................... 47
    4.2.1 Environmental Threats .............................................................................. 49
    4.2.2 Airline Threats ............................................................................................. 49
  4.3 Errors ..................................................................................................................... 51
List of Figures

Figure 1. The ‘Iceberg Model’ of Accidents .................................................................5
Figure 2. SHELL Model ..............................................................................................6
Figure 3. Human Elements of Accident Causation .....................................................8
Figure 4. Human Factors and Classification System ..................................................10
Figure 5. Model of Flight crew Error Management .....................................................11
Figure 6. Model of Flight Crew Error ......................................................................12
Figure 7. Total Percentage Classification — Threat ....................................................48
Figure 8. Frequency of Environmental Threats ...........................................................49
Figure 9. Frequency of Airline Threats ......................................................................50
Figure 10. Total Percentage Classification — Error .....................................................52
Figure 11. Frequency of Aircraft Handling Errors ......................................................53
Figure 12. Frequency of Procedural Errors .................................................................54
Figure 13. Frequency of Communication Errors .........................................................56
Figure 14. Frequency of UASs ..................................................................................57
Figure 15. Total Percentage of Subcategory UAS ........................................................58
Figure 16. Phase of Flight by Occurrence Type ..........................................................59
Figure 17. Frequency of Reported Occurrences by Type ............................................60
Figure 18. Reported Occurrence Type by Year ............................................................61
Figure 19. Total Percentage of Threats and Errors ....................................................62
Figure 20. Time of Reported Occurrences: Accidents, Airspace Incidents & Incidents ................................................63
Figure 21. Geographic Location of Reported Occurrences .........................................64
Figure 22. Classification Consistency Results .............................................................66
Figure 23. Pilot Hours—Last 90 Days .......................................................................68
Figure 24. Pilot Hours—Total Flying Time .................................................................69
Figure 25. Pilot Hours—On Aircraft Type .................................................................70
Figure 26. Incidents by Flight Rules ........................................................................71
Figure 27. Airspace Incidents by Flight Rules .............................................................72
Figure 28. Accidents by Flight Rules ........................................................................73
Figure 29. Seasonal Reporting ..................................................................................74
Figure 30. Killing Zone—Fatal Accidents ..................................................................103
Figure 31. Subcategory Geographic Location of Safety Occurrences .........................137
Figure 32. Mountainous Zones—North Island ............................................................139
Figure 33. Mountainous Zones—South Island ...........................................................140
List of Tables

Table 1. Aircraft Statistics Category ................................................................. 4
Table 2. Classification Consistency Results ...................................................... 44
Table 3. Environmental Threat Categories ....................................................... 126
Table 4. Aircraft Threat Categories ................................................................... 126
Table 5. Aircraft Handling Error Categories ...................................................... 126
Table 6. Procedural Error Categories .................................................................. 128
Table 7. Communication Error Categories .......................................................... 128
Table 8. Undesirable Aircraft State Categories .................................................. 129
Table 9. Subcategory Event Table of Environmental Threats ............................. 130
Table 10. Subcategory Event Table of Airline Threats ........................................ 131
Table 11. Subcategory Event Table of Aircraft Handling Errors ...................... 132
Table 12. Subcategory Event Table of Procedural Error ..................................... 133
Table 13. Subcategory Event Table of Communication Errors ......................... 134
Table 14. Subcategory Event Table of UASs ...................................................... 135
Table 15. Totals for Phase of Flight ................................................................... 136
Table 16. Totals for Geographic Location ........................................................... 138
Table 17. Environmental Threat Occurrence Examples .................................... 141
Table 18. Airline Threat Occurrence Examples .................................................. 142
Table 19. Aircraft Handling Error Occurrence Examples .................................. 143
Table 20. Procedural Error Occurrence Examples ............................................. 144
Table 21. Communication Error Occurrence Examples ..................................... 145
Table 22. UAS Occurrence Examples ................................................................. 146
Glossary

**Accident:** an occurrence that is associated with the operation of an aircraft and takes place between the time any person boards the aircraft with the intention of flight and such time as all such persons have disembarked and the engine or any propellers or rotors come to rest.

(1) A person is fatally or seriously injured as a result of
   a. being in the aircraft;
   b. direct contact with any part of the aircraft, including any part that has become detached from the aircraft; or
   c. direct exposure to jet blast except when the injuries are self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to passengers and crew; or

(2) the aircraft sustains damage or structural failure that
   a. adversely affects the structural strength, performance or flight characteristics of the aircraft; and
   b. would normally require major repair or replacement of the affected component,

except engine failure or damage that is limited to the engine, its cowlings, or accessories, or damage limited to propellers, wing tips, rotors, antennas, tyres, brakes, fairings, small dents, or puncture holes in the aircraft skin; or

(3) aircraft is missing or is completely inaccessible (CAANZ, 2009c).

**Classifications:** judgements or decisions made to determine whether a threat, error or UAS was present in each occurrence.

**Errors:** errors are defined as flight crew actions or inactions that:

(1) lead to a deviation from crew or organisational intentions or expectations,

(2) reduce safety margins, and
(3) increase the probability of adverse operational events on the ground or during flight (Merritt & Klinect, 2006).

**Incident:** any occurrence, other than an accident, that is associated with the operation of an aircraft and affects, or could affect, the safety of operation (CAANZ, 2009c).

**Occurrence:** an accident or incident (CAANZ, 2009c).

**Threats:** defined as events or errors that:

1. occur outside the influence of the flight crew (i.e. not caused by the crew);
2. increase the operational complexity of a flight; and
3. require crew attention and management if safety margins are to be maintained (Merritt & Klinect, 2006).

**Undesirable Aircraft States (UAS)** is defined as a position, speed, attitude, or configuration of an aircraft that:

1. results from flight crew error, actions, or inaction,
2. clearly reduces safety margins (Merritt & Klinect, 2006).