Civil Aviation Authority of New Zealand: Flight Training Review

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Table of Contents

1 Executive Summary 5
2 Introduction 7
2.1 Scope 8
2.2 Limitations and Caveats 8
3 Background 9
4 Methodology 10
5 Analysis 11
5.1 Quantitative Data Analysis and Trends 11
Data Analysis Methodology and Limitations 11
Flight Training Industry 11
Flight Training Fatalities and Injuries 14
Flight Training Occurrence Types 17
Pilot Exam Performance 20
Future Quantitative Analysis 22
5.2 Strategic Issues 24
5.3 Regulation of Flight Training 26
Rule Part 141 Aviation Training Organisations – Certification 26
Rule Part 61 27
Rule Part 91 27
5.4 Review of Major Accidents 28
Mid-Air Collision – ZK-MBD and ZK-MBL (09 February 2006) 28
Mid-Air Collision – C152 ZK-ETY and R22 ZK-HGV (17 February 2008) 29
Mid-Air Collision C152s ZK-JGB and ZK-TOD (26 July 2010) 29
C152 ZK-KID Impact with Terrain (26 October 2007) 30
PA 28 ZK-LJB Impact with Terrain near Cass Saddle (16 January 2008) 30
ZK-EHY – Flight Test Accident – Ruahine Ranges (12 July 2010) 31
Discussion of Mid Air Collisions 31
Discussion of Mountain Flying Accidents 34
6 Findings 34
7 Recommendations 36
8 Annex A Requested Data Set 37
9 Annex B Possible Data Set – Training Reports 37
10 Bibliography 39

List of Abbreviations

AIA	Aviation Industry Association of New Zealand
ATSB	Australian Transport Safety Bureau
ASL	Aviation Services Ltd
BASI	Bureau of Air Safety Investigation (now Australian Transport Safety Bureau)
CAANZ	Civil Aviation Authority of New Zealand
CPL	Commercial Pilot Licence
ICAO	International Civil Aviation Organization
TAIC	Transport Accident Investigation Commission of New Zealand

List of Figures

Figure 1 - Flight Training by Location and Concentration (funded training only) (CAANZ, 2010b) 10
Figure 2 - Flight training industry 12
Figure 3 - Rate of occurrences, 2000-2010 12
Figure 4 - Reported Training Occurrence Types, 2000-2010 13
Figure 5 - Rate of Occurrence Types, 2000-2010 14
Figure 6 - Flight Training Fatal Accident Rate, 2000-2010 15
Figure 7 - Flight Training Accident Rate, 2000-2010 16
Figure 8 - Flight Training Non-Fatal Injury Rate, 2000-2010 16
Figure 9 – Flight training occurrence types, 2000-2010 17
Figure 10 - Dual Flight Training Occurrence Types , 2000-2010 17
Figure 11 - Solo Flight Training Occurrence Types, 2000-2010 18
Figure 10 - Solo Training Airspace Incidents, 2000-2010 18
Figure 11 - Dual Training Airspace Incidents, 2000-2010 19
Figure 12 - CPL Flight Test Performance (ASPEQ, 2011) 20
Figure 13 - CPL Exam Performance (ASPEQ, 2011) 21
Figure 14 - Pass Rates - Flight Tests (ASPEQ, 2011) 22

List of Tables

Table 1 - Flight Training Fatalities and Injuries, 2000-2010 14
Table 2 - Most frequently identified training occurrence causes, 2000-2010 23

1 Executive Summary

The flight training sector of the New Zealand aviation industry is important to New Zealand as a source of future transport pilots, an earner of overseas income and a major employer. An important factor in maintaining its position in the market is New Zealand's reputation as a respected and well regulated member of the International Civil Aviation Organisation (ICAO) with a low accident rate. The Civil Aviation Authority of New Zealand commissioned Aerosafe Risk Management to undertake this review of flight training accidents and serious incidents to identify:

- The causal factors in each case;
- Any common causes;
- Trends evidenced during the period under review, and likely causes of those trends; and
- Safety regulatory actions/interventions that could address causes.

CAANZ provided a raw data set which was analysed. As the sample size was relatively small, care should be taken when drawing conclusions from the quantitative analysis. The key findings were:

- There have been 135 flight training accidents reported to CAANZ in the period 2000-2010 and 13 fatalities.
- In 2010 the rate of non-fatal injuries as a result of flight training operations was 1.3 per 100,000 hours.
- Quantitative data on training operations in New Zealand is somewhat inconsistent, and stored in a manner which does not allow easy and flexible access, for all stakeholders.
- In the period 2000-2010 there has been an overall increase in the number of occurrences relating to flight training reported to CAANZ. 202 occurrences per 100,000 hours were reported in 2010, up from 81 per 100,000 hours in 2000.
- The fatal accident rate and the number of fatalities during flight training activities have increased since 2006, with 1.3 fatal accidents per 100,000 hours in 2010.

The trend in airspace incidents was further investigated as such incidents had increased dramatically to 92 per 100,000 hours in 2010, well beyond increases in other occurrence types.

A preliminary review of strategic issues illustrated the importance of sector to the New Zealand economy. Discussion of the regulatory framework around flight training focussed on Rule Parts 61, 91 and 141 and it was noted that updates to the Rules and the full introduction of Part 141 are matters to be considered.

An examination of three mid air collision fatal accidents and three mountain terrain fatal accidents was made. The efforts that CAANZ have made to mitigate risks in both of these areas since 2000 was impressive however in both areas there is a need for ongoing and formal monitoring as new generations of pilots and instructors enter the industry. Key findings from the investigation of mid-air collision/near miss scenarios were:

- Review and simplifying aerodrome procedures,
- Review simplifying and optimising airspace design and
- Continue the education programme on the importance of situational awareness and the inherent limitations of both un-alerted and alerted “see and avoid”.

Nine recommendations to CAANZ are included in Section 7 of this report.

2 Introduction

Every activity undertaken by organisations or individuals has its own inherent risks. Aviation and flight training are no different. While risks cannot be eliminated, they can be managed and reduced to acceptable levels. A key to achieving this is the effective identification, analysis and monitoring of safety data within the industry sector being examined as part of the overall sector risk profile.

The Civil Aviation Authority of New Zealand (CAANZ) commissioned Aerosafe Risk Management (Aerosafe) to undertake a review of the safety performance of the New Zealand flight training sector for the years 2000 to 2010.

The aim of this review of flight training accidents and serious incidents was to identify:

- The causal factors in each case;
- Any common causes;
- Trends evidenced during the period under review, and likely causes of those trends; and
- Safety regulatory actions/interventions that could address causes.

While focussing on activities over the last ten years, the review also sought to establish if there had been any identifiable increases in accident or serious incident rates over any period during this timeframe, and if so, the reasons for this. Trends and likely causes were also identified, along with other information of relevance to the safety performance of the sector. While time did not allow the detailed examination of every incident and accident in the flight training sector, six accidents involving fatalities were examined in detail. The accidents were selected after discussions with CAANZ staff as representative of two major risk areas affecting flight training:

- Mid –air collision – ZK-MBD and ZK-MBL
- Mid-air collision – C152 ZK-ETY and R22 ZK-HGV
- Mid-air collision C152s ZK-JGB and ZK-TOD
- C152 ZK-KID impact with terrain
- PA28 ZK-LJB impact with terrain
- ZK-EHY – flight test accident.

2.1 Scope

The review focussed on flight training activities in New Zealand involving certificated (standard or restricted) fixed-wing and rotary-wing aircraft for the period 2000-2010. It excludes training activity involving micro-light aircraft, hang gliders and parachuting.

The extent and importance of the sector are discussed later in this report, however, in summary it is significant to the country and has grown from 98,000 total training hours in the year 2000 to 198,639 hours in 2009. In the year 2000, 20% of the operators reported 90% of the training hours whereas in 2009, 13% of the operators reported 90% of the hours. In the year 2000, 9.9% of the hours were helicopter training with the remainder being fixed wing. In the year 2009, the corresponding figure was 11.3% (Civil Aviation Authority of New Zealand (CAANZ), 2010b).

For the purposes of the review:

- Flight training activity was considered as any activity involving the delivery of dual flight time instruction by an appropriately licenced and rated instructor to a student, and any solo flight activity by a student for the purposes of obtaining a Private Pilot licence or a Commercial Pilot licence.
- Dual flight time means flight time during which a person is receiving flight instruction from an appropriately licenced and rated pilot on board a dual control aircraft.
- Flight instruction means instruction in the control of aircraft in basic and advanced flight manoeuvres, and includes:

    - Instruction in respect from conversion from fixed-wing to rotary-wing aircraft or from rotary-wing to fixed-wing aircraft
    - Flight training instruction for the purposes of issue or renewal of ratings associated with a Private Pilot Licence or a Commercial Pilot Licence (e.g. and instrument rating).

2.2 Limitations and Caveats

This report is subject to the following limitations:

1. The report was compiled using only internal CAANZ data, samples of Aviation Services Limited (ASL) data and publicly available Transport Accident Investigation Commission of New Zealand (TAIC) reports.

2. No consultation was undertaken with agencies, organisations or individuals external to CAANZ and ASL.
3. The relatively small data sample available requires any quantitative analysis to be viewed with care.
4. CAANZ specialists advised that the reports reflect what they are told. This may or may not be what actually happened.
5. Occurrence statistics address reported occurrences only. Organisations with robust reporting cultures therefore show as having a greater number of reports. An inference should not be drawn that as they have more reports, they have a worse safety record. In fact, the opposite may be the case.
6. Matters associated with the funding of flight training were outside the scope of the review.

3 Background

The flight training sector of the New Zealand aviation industry is diverse, ranging from recreational operations such as gliding and war birds to advanced qualifications such as the commercial pilot licence and associated instrument ratings. It is of significant economic importance to the country and has grown from 98,000 total training hours in the year 2000 to 198,639 hours in 2009. In the year 2000, 20% of the operators reported 90% of the training hours whereas in 2009, 13% of the operators reported 90% of the hours. In the year 2000, 9.9% of the hours were helicopter training with the remainder being fixed wing. In the year 2009, the corresponding figure was 11.3% (Civil Aviation Authority of New Zealand (CAANZ), 2010b).

Both theory and flight training are provided by private sector operators at various locations around New Zealand, theory testing is provided by ASL and flight testing by approved examiners as discussed later in this report. Approximately $1.2m per annum is spent on theory examinations with approximately $2m spent on flight tests (ASPEQ, 2011). There is a wide spectrum of training organisations ranging from large commercial operators providing training to professional licence standard catering to both domestic and international students, through flying clubs to single person operations and special interest subsectors of the industry. Training tends to be concentrated in certain geographic areas. The distribution for 2009 is shown in Figure 1.

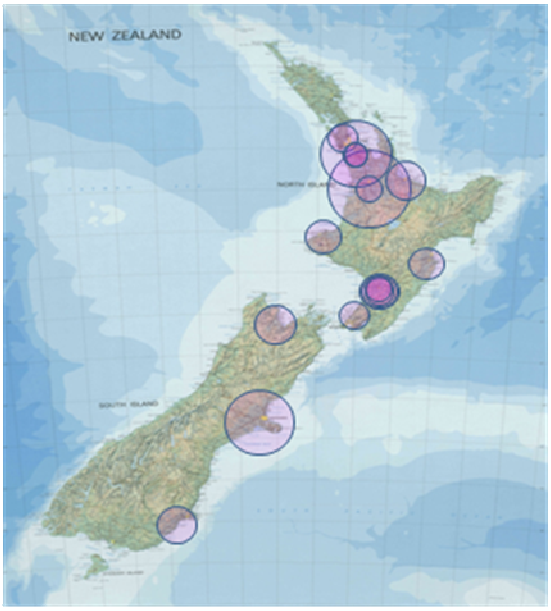

Figure 1 - Flight Training by Location and Concentration (funded training only) (CAANZ, 2010b)

4 Methodology

Flight training is a crucial element in the ongoing safety of aviation in New Zealand. A review of the industry sector was commissioned by CAANZ to establish the size, expansion and economic importance of the sector to New Zealand. This was undertaken in order to identify any trends in flight training accident and incident in the period 2000-2010 and possible safety regulatory actions that could address the likely causes of the trends.

A multi-faceted approach was used in order to analyse the safety performance of the sector, with a particular focus on accidents and serious incidents in the period of interest. Data sources used for this analysis included:

- CAANZ safety occurrence data;
- Site visit to CAANZ including interviews with CAANZ staff in the safety data analysis and personnel licensing groups;
- Internal CAANZ reports;
- Information in the public domain about the flight training sector;
- TAIC accident reports; and
- ASL examination records.

Six high profile accidents involving fatalities were reviewed in detail to establish any common causes or linkages. This analysis included a review of training records held

by ASL to examine whether performance in examinations and tests provided any indicators for future pilot performance.

5 Analysis

A set of raw data was requested from CAANZ as described in Annex A of this report. This data was analysed as described in Section 5.1 of this report. As the available data set is relatively small, a multi-pronged approach to the analysis was implemented. Next, a strategic review of recent reports established the context of flight training to New Zealand. The regulatory framework for the sector was then examined followed by a review of six major accidents and finally an examination of the available data for trends in flight training accidents.

5.1 Quantitative Data Analysis and Trends

Data Analysis Methodology and Limitations

The data used in the following sections was made available by CAANZ upon request; its format is detailed in Annex A. The occurrences used in the analysis are any which for which the "Nature of the Flight" is recorded as "Training – Solo" or "Training – Dual" in the CAANZ Occurrence Database. This includes occurrences involving aeroplanes, helicopters, gyrocopters, and gliders. The analysis does not include flight training occurrences in micro-light aircraft, hang gliders, or parachutes.

Some limitations specifically arising from the quantitative data analysis are:

1. Inconsistencies in the total number of flight training occurrences recorded in the CAANZ Occurrence Database. It is possible that some events were not consistently recorded or coded in order to be reliably extracted from the Database.
2. Possible inconsistencies in the coding of flight training occurrence details.
3. Limited number of investigations into flight training occurrences resulting in unverified, possibly incorrect or inaccurate, information recorded by CAANZ. CAANZ staff advised the review that the information held might be incomplete and that it was sometimes accepted as reported without further verification.

Flight Training Industry

The number of flight training hours recorded each year has generally grown since 2000, shown in Figure 2. The three year moving average for flight training hours recorded in 2010 was 162,700 hours, up from 97,000 in 2000. Despite this increase

in the number of hours, the number of training operators has decreased from 273 in 2000, to 191 in 2010. The lull in training hours in the middle of the decade, which could be attributed to the change in demand for pilots in the world wide aviation industry (CAANZ, 2010a, p. 2), forms part of the steady decrease in the number of training operators since 2005.

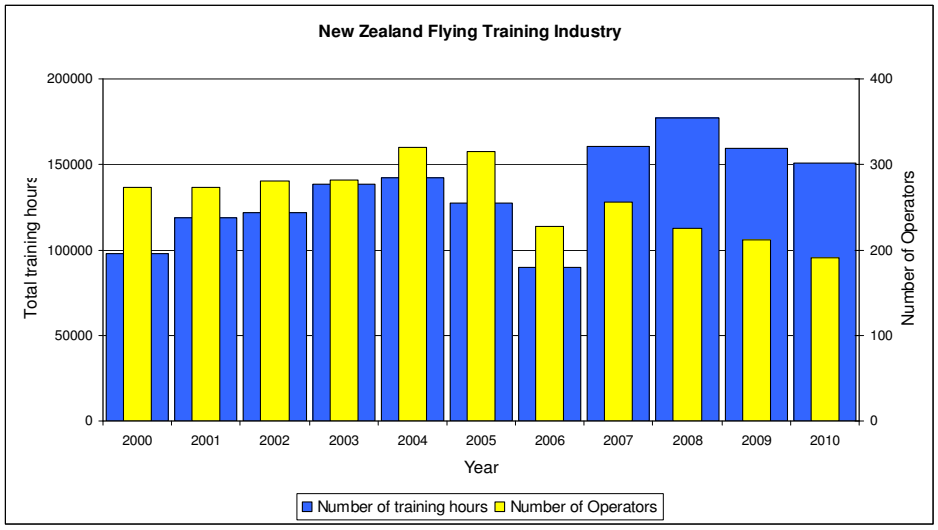

Figure 2 - Flight training industry

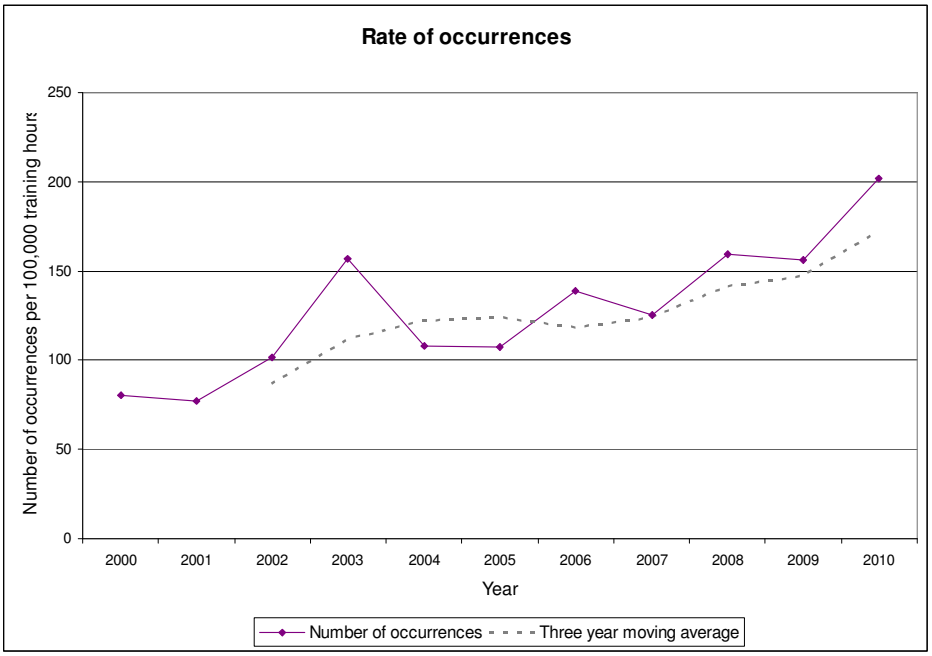

Figure 3 - Rate of occurrences, 2000-2010

The rate of occurrences, which is all accidents and incidents, over the period of interest climbed steadily as depicted in Figure 3. An increase in the number of

occurrences does not necessarily reflect a poor safety performance, but may rather demonstrate an improved reporting culture as discussed elsewhere in this review.

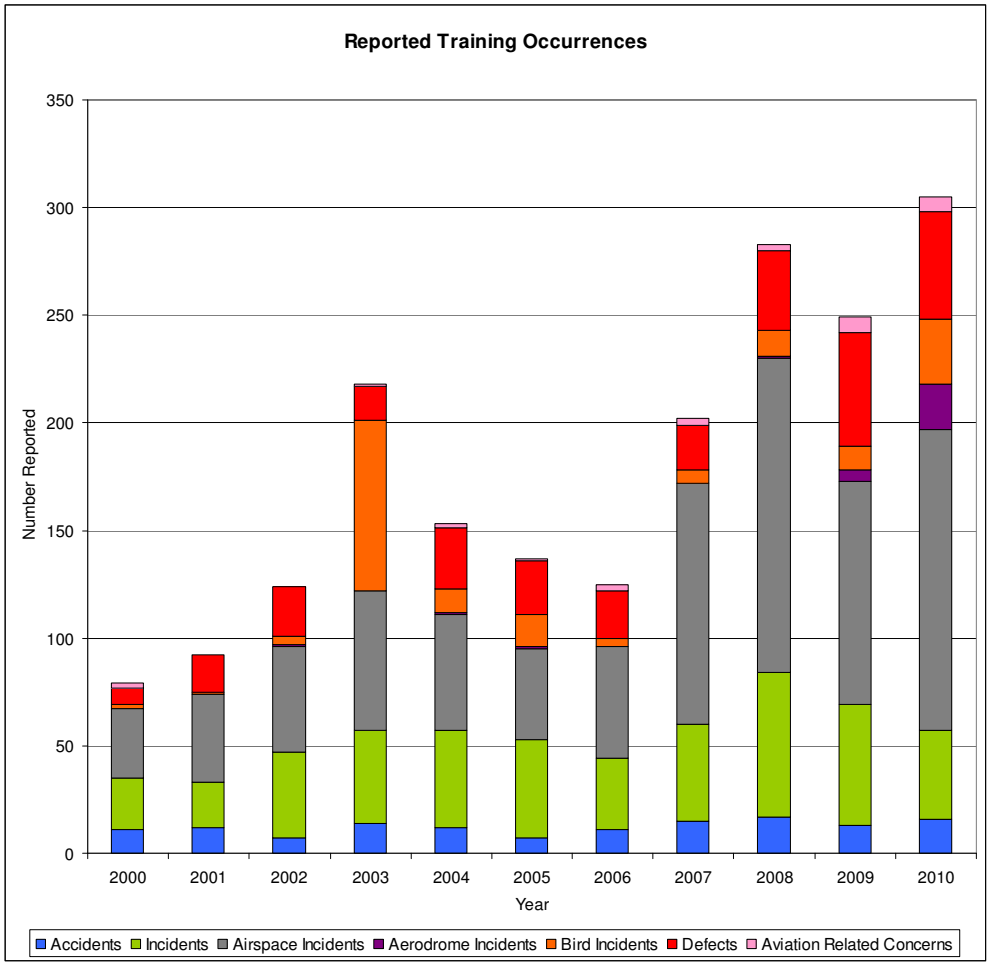

Figure 4 - Reported Training Occurrence Types, 2000-2010

CAANZ categorises occurrences into one of fifteen “Occurrence Types”. During the period of study, only seven Occurrence Types are represented in flight training occurrences. The rate of each Occurrence Type shown in Figure 4 has generally increased particularly, “Airspace Incidents” and “Aerodrome Incidents”. The two Occurrence Types which were consistently represented, as a function of total flight training hours, are “Accidents” and “Incidents”.

The increase in the number of “Airspace Incidents” and “Aerodrome Incidents” may be attributed to the concentration of flight training activities, as highlighted in Figure 1, or possibly as a result of poor application of see-and-avoid techniques, as discussed in relation to specific training occurrences in Section 5.4. CAANZ have an ongoing education programme to highlight the importance of “looking out” and its inherent limitations.

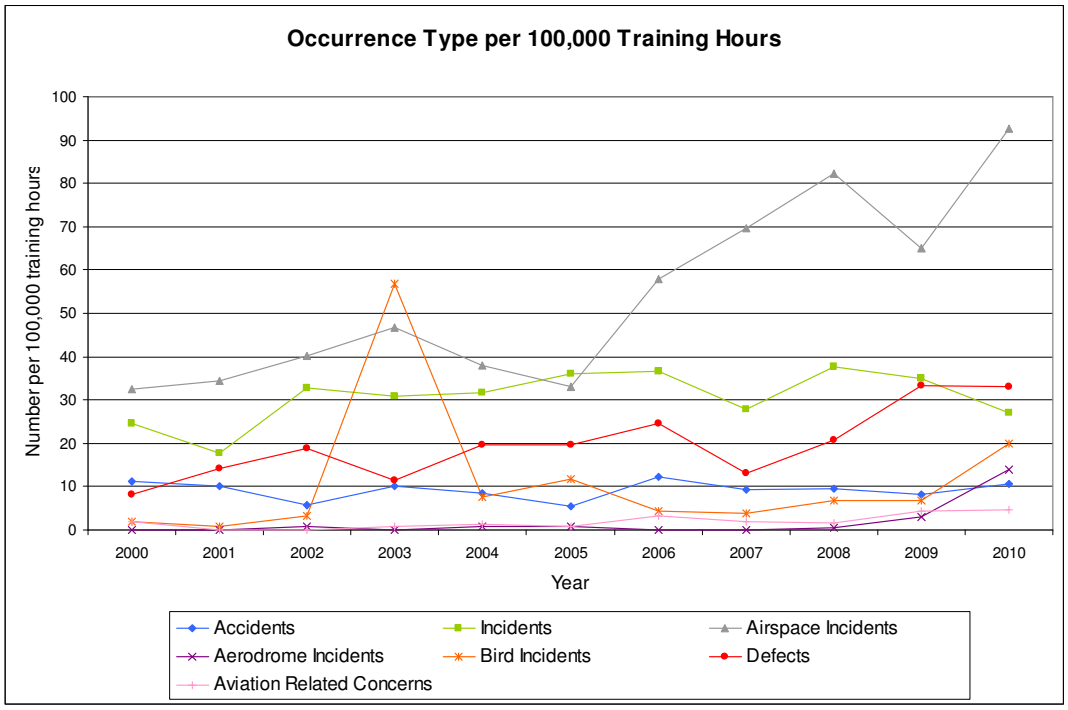

Figure 5 - Rate of Occurrence Types, 2000-2010

Flight Training Fatalities and Injuries

In the period 2000-2010 there were 38 occurrences which resulted in either fatalities or non-fatal injuries, with a total of 13 fatalities and 40 non-fatal injuries as a result of flight training, shown in Table 1.

Year	00	01	02	03	04	05	06	07	08	09	10
No. of fatal accidents	0	0	0	3	0	0	2	1	1	2	2
No. of fatalities	0	0	0	3	0	0	2	1	1	2	4
No. of occurrences resulting in non-fatal injuries	1	1	2	2	1	3	4	5	4	4	2
No. of non fatal injuries	1	2	2	3	1	5	7	6	4	6	3

Table 1 - Flight Training Fatalities and Injuries, 2000-2010

The rate of fatalities per 100,000 hours of flight training has increased since 2006, see Figure 6. The average fatality rate in 2010 was 1.5 per 100,000 hours. The

increase in the number and rate of fatalities during flight training is not able to be conclusively attributed to any change in the industry. The 2010 CAANZ internal analysis of the flight training sector did note that there has been a 200% increase in the number of CPLs (Commercial Pilots Licence) issued to non New Zealand nationals in the period 2006-2010. Whether this is shift in the demographic of pilots undertaking flight training is related to the increase in the fatality rate will require further investigation by CAANZ.

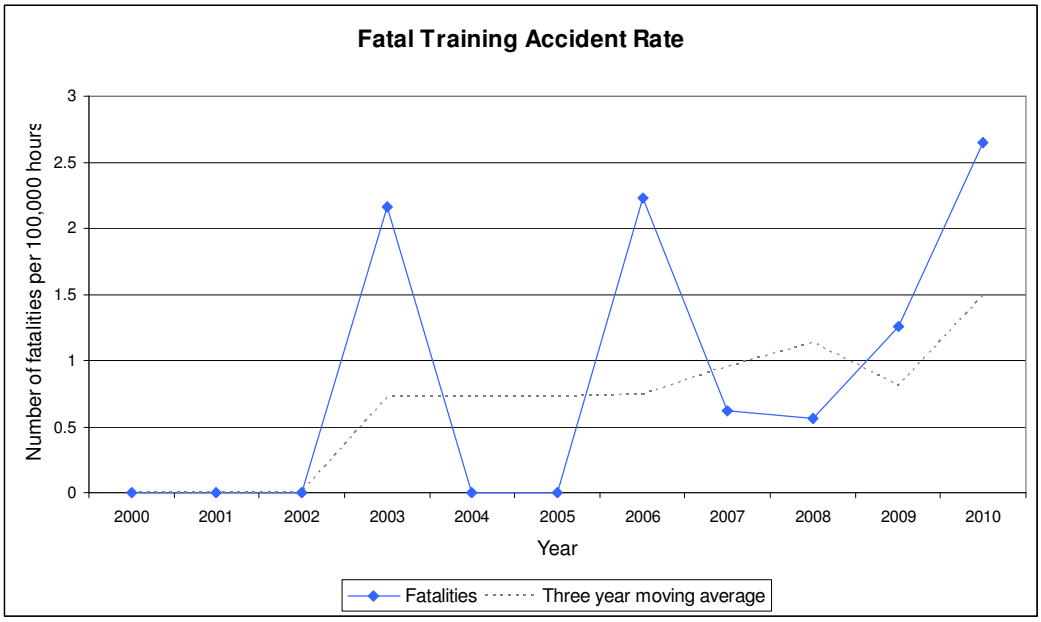

Figure 6 - Flight Training Fatal Accident Rate, 2000-2010

The rate of flight training accidents has increased since 2005, as highlighted in Figure 7, with the average accident rate for the sector in 2010 being 9.4 per 100,000 hours, up from a low of 8.0 in 2005. The overall rate of flight training accidents in the period 2000 to 2010 is steady around 9.0 accidents per 100,000 hours. The spikes in flight training accidents in Figure 7 are not attributable to known changes in the sector during the period.

The number of non-fatal injuries during flight training has decreased since a peak in 2006, shown in Figure 8. What has instigated this reduction has not been determined.

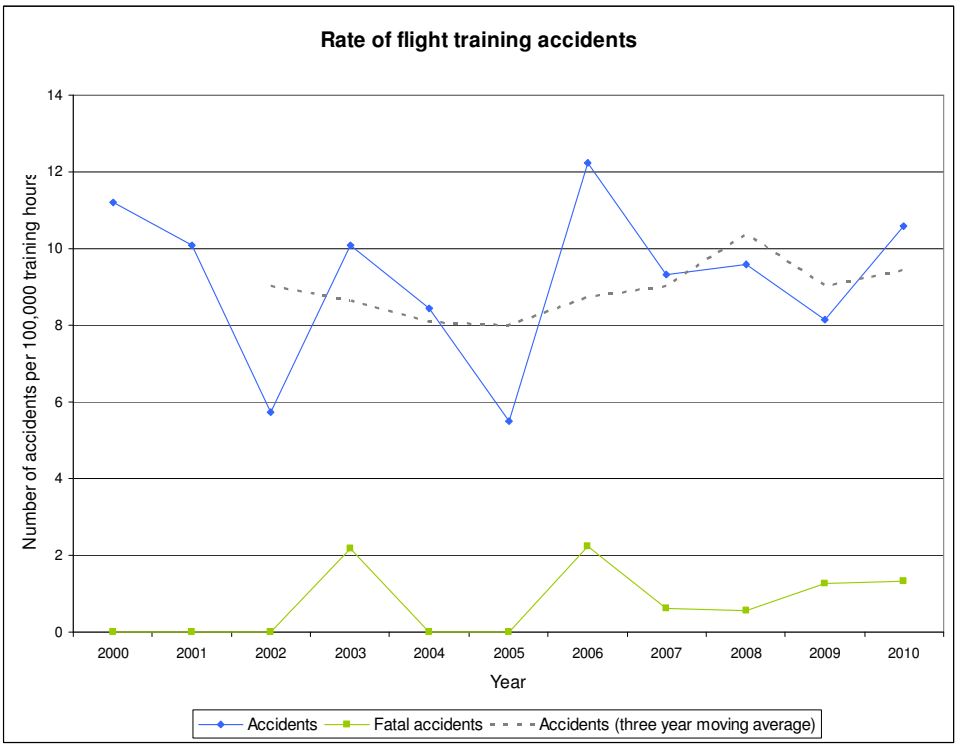

Figure 7 - Flight Training Accident Rate, 2000-2010

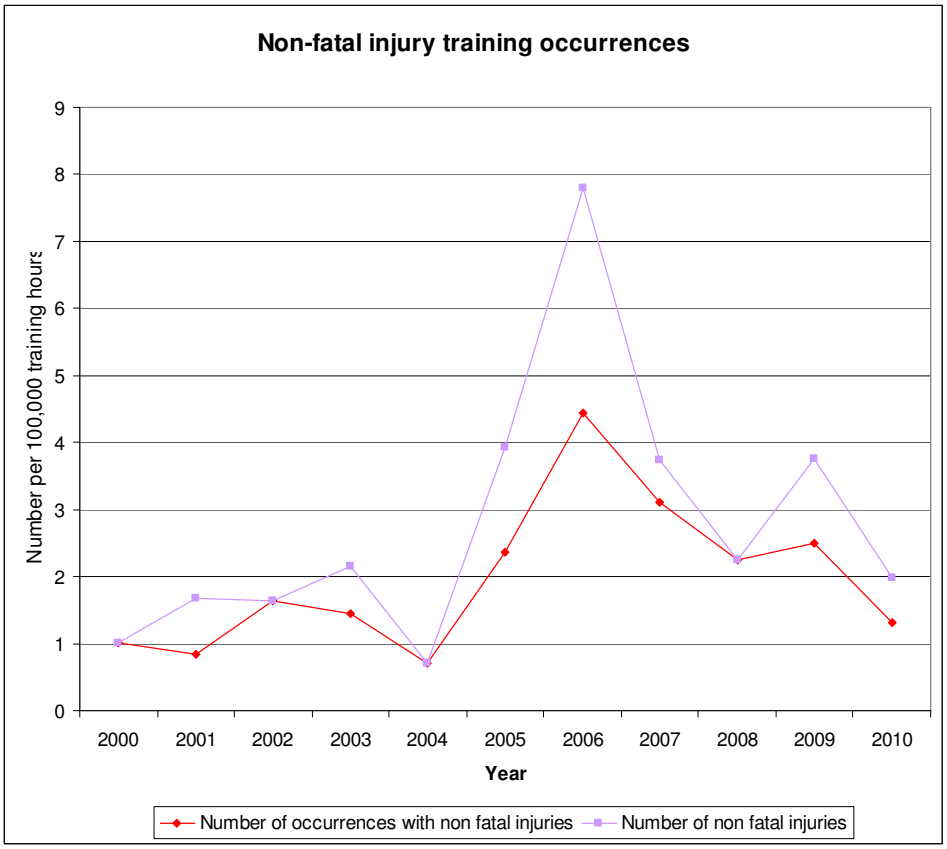

Figure 8 - Flight Training Non-Fatal Injury Rate, 2000-2010

Flight Training Occurrence Types

The category of all flight training occurrences for the period is shown in Figure 9. When the Occurrence Types are viewed separately for both dual and solo flight training, in Figure 10 and Figure 11 respectively, there is a marked difference in the proportion of each Occurrence Type. “Airspace Incidents” accounted for 55% of solo training occurrences, and 30% for dual training. “Defects” and “Bird Incidents” are more common throughout dual training. This may be due to encouragement by the Flight Instructor to identify and report such occurrences however no conclusive reason was found.

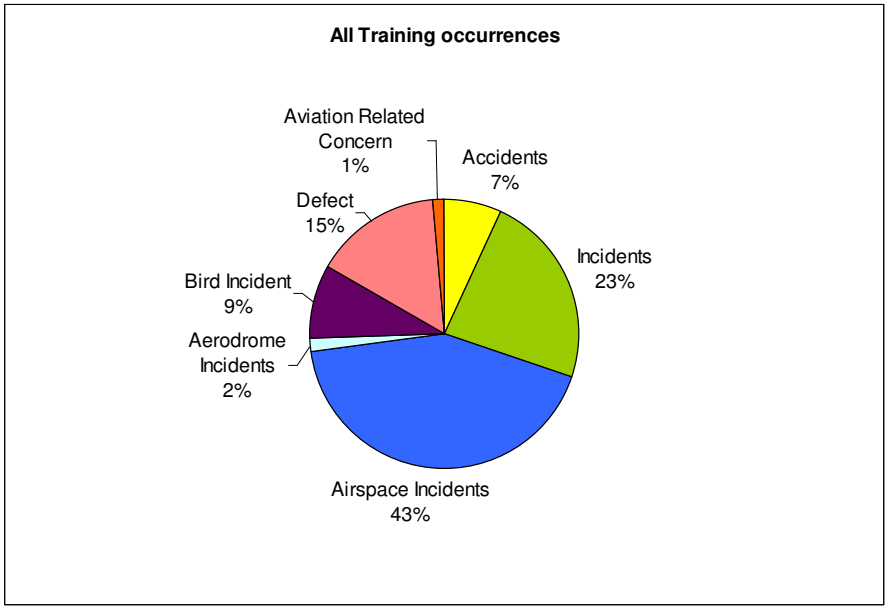

Figure 9 – Flight training occurrence types, 2000-2010

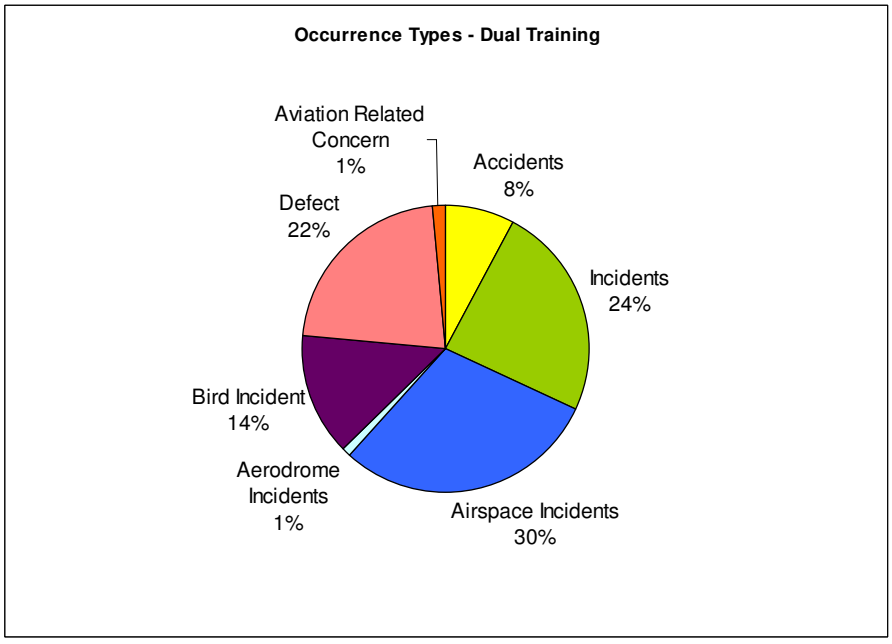

Figure 10 - Dual Flight Training Occurrence Types, 2000-2010

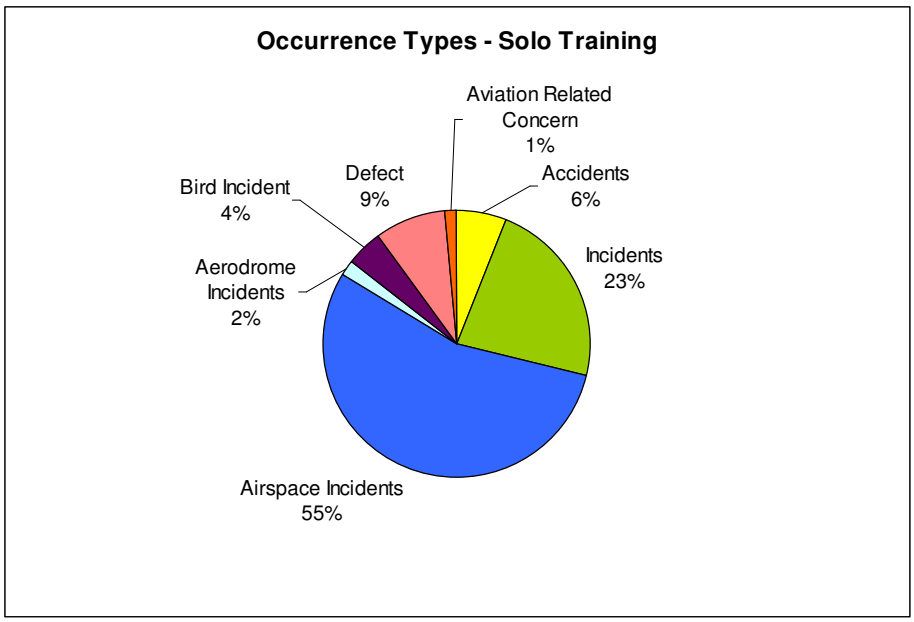

Figure 11 - Solo Flight Training Occurrence Types, 2000-2010

The description of the "Airspace Incidents" was further investigated in order to determine if any trend is perceptible in terms of the difference between solo and dual flight training. CAANZ assigns one or more "Occurrence Descriptors" to each occurrence and these classifications were used in the following analysis.

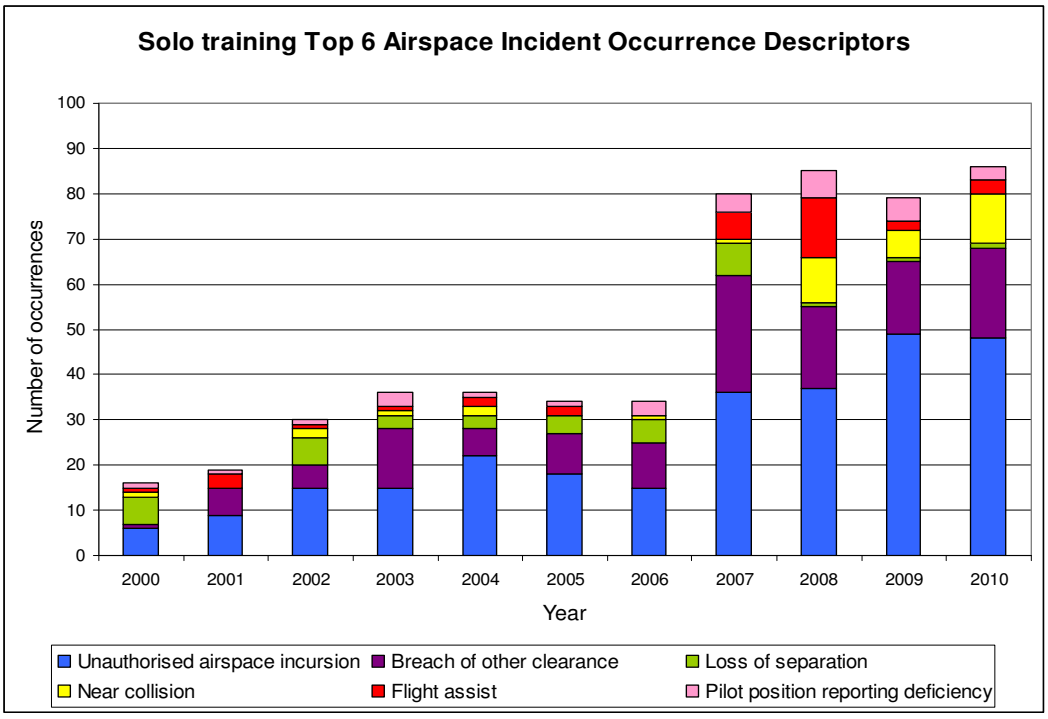

Figure 12 - Solo Training Airspace Incidents, 2000-2010

Figure 12 and Figure 13 detail the six most common “Occurrence Descriptors” of “Airspace Incidents” for solo and dual training respectively. Note that more than one “Occurrence Descriptor” may be assigned to each occurrence. The six “Occurrence Descriptors” in Figure 12 accounted for 85% of all solo training Airspace Incidents in the period 2000-2010. The six “Occurrence Descriptors” in Figure 13 accounted for 75% of all dual training Airspace Incidents in the same period.

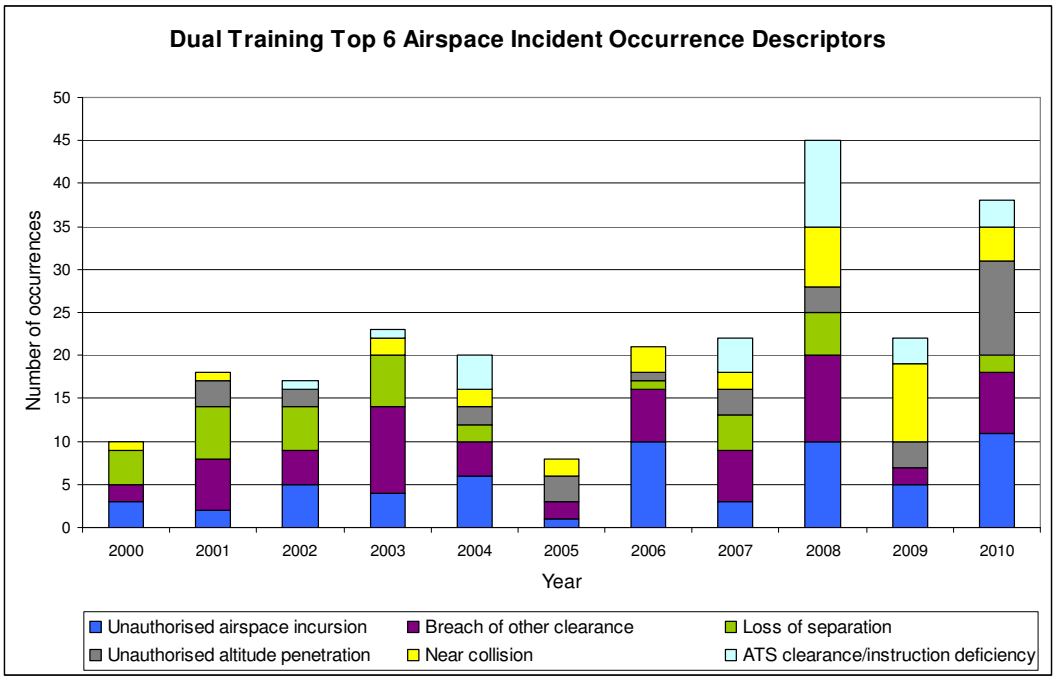

Figure 13 - Dual Training Airspace Incidents, 2000-2010

“Unauthorised airspace incursion” was the most frequently recorded “Occurrence Descriptor” for both solo and dual flight training. This may be the result of the concentration of training schools highlighted in Figure 1, which coincide with areas of high air traffic due to other operations. While it is not able to be determined from this analysis, the increasing number of flying training in a controlled airspace, which in turn is complex, may also be a contributing factor to the high number of unauthorised airspace incursions.

Other than the difference of magnitude between the number of each “Occurrence Descriptor” for solo and dual flight training, an interesting point is the presence of both “Flight Assist” and “Pilot Reporting Position Deficiency” descriptors in solo training. It is possible that student pilots are less competent when interacting with other stakeholders in controlled airspace.

For each type of “Occurrence Descriptor” there has been an increase in the number of reported instances since 2006. The total effect of this is shown in Figure 5, where it is evident that “Airspace Incidents” have increased at a rate beyond all other Occurrence Types, and out of proportion with overall reporting during the period.

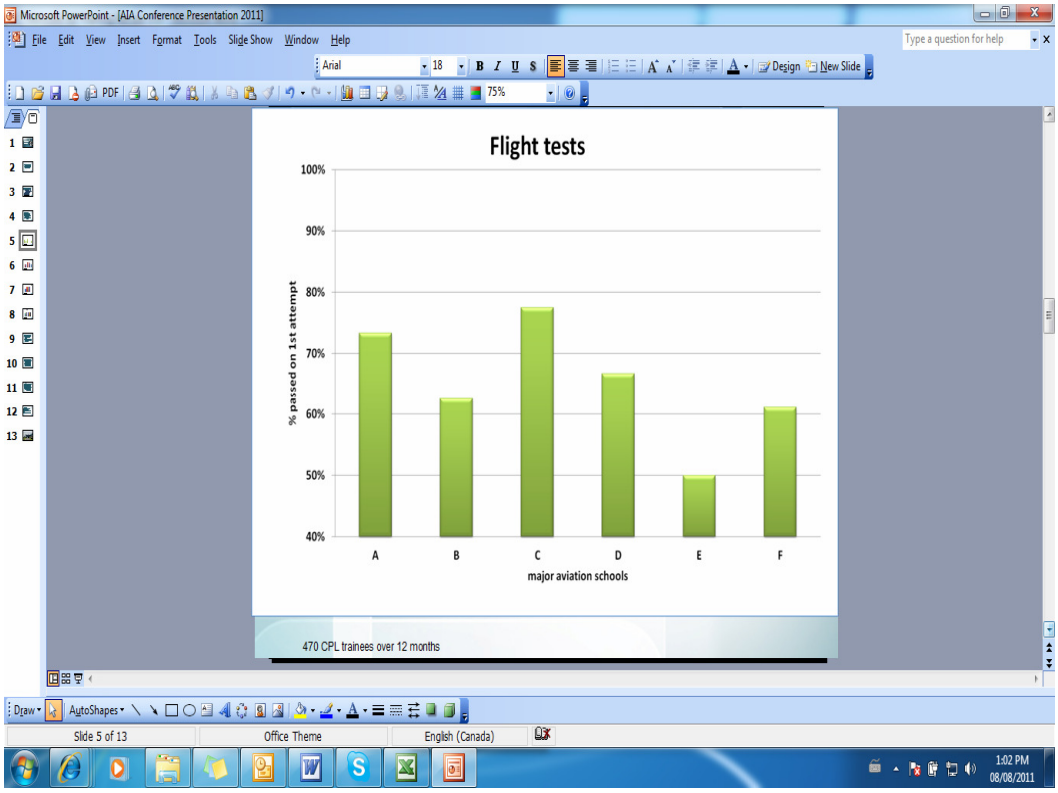

Figure 14 - CPL Flight Test Performance (ASPEQ, 2011)

Pilot Exam Performance

ASPEQ made a presentation at the 2011 AIA Conference on their perception of pilot qualifications, several issues raised deserve consideration. The sample investigated by ASPEQ consists of 470 CPL trainees from six major flying schools over a twelve month period. The pass rates for flight tests, see Figure 14, range from 78% to 50% (ASPEQ, 2011). Figure 15 shows the pass rates for the same schools in CPL examinations in meteorology and air law.

There is no obvious correlation between performance in theoretical examinations and the performance in flight test, and no research relates the performance in theoretical and practical examinations, or performance in examinations and post-examination performance. A closer analysis of the results in both flight tests and examinations, using data available from ASL, to determine if there is a link between examination performance, and frequency and severity of occurrences during and after training,

may reveal a trend between student pilot performance in examinations and performance in the air, during and post training. Similarly investigating any relationship between student pilot performances, in examinations or reported occurrences, may highlight training schools which do not produce a high-quality pilot, in skills and/or knowledge. If trends are identified following either of these investigations, CAANZ may be able to implement intervention measures to address the cause of the trend.

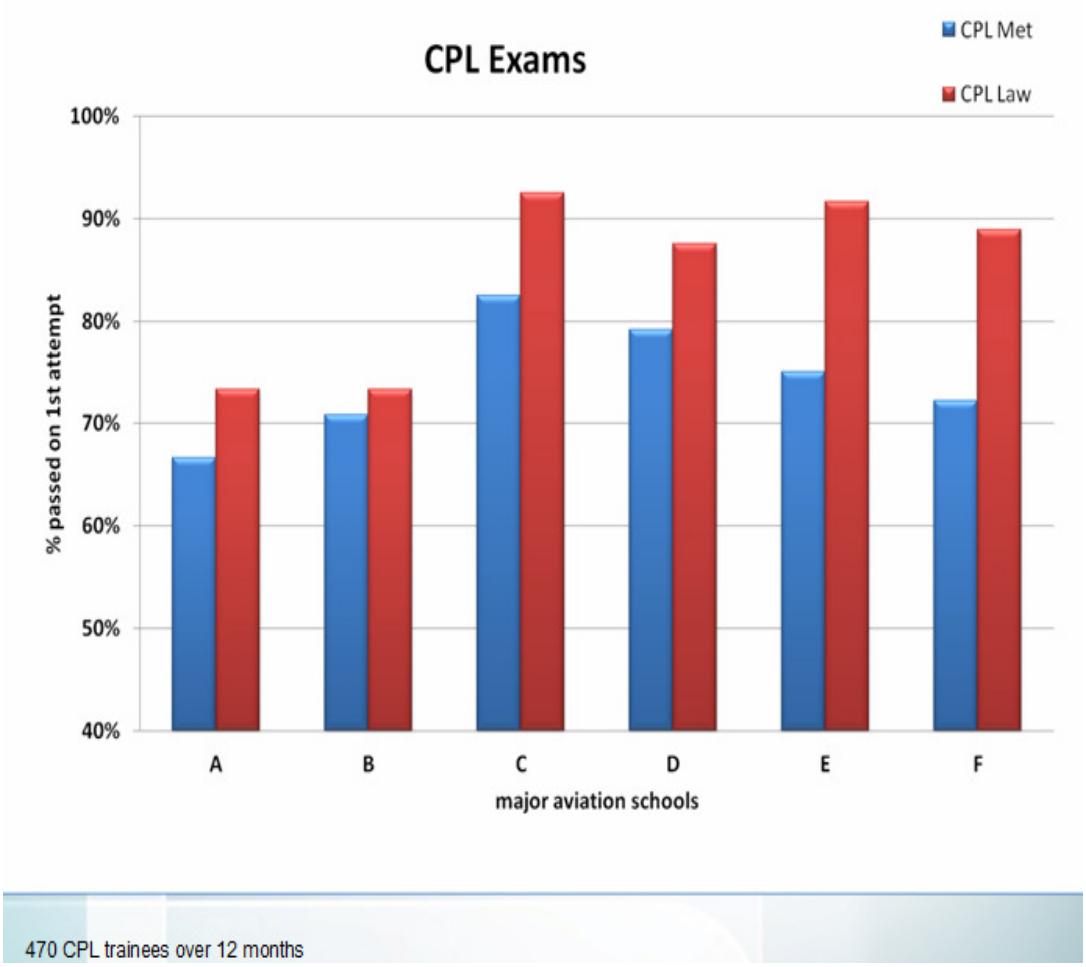

Figure 15 - CPL Exam Performance (ASPEQ, 2011)

Figure 14 shows the pass rates of the 470 CPL students in flight tests. Approximately 65% pass at first attempt while a small percentage, less than 10%, require more than two attempts to pass.

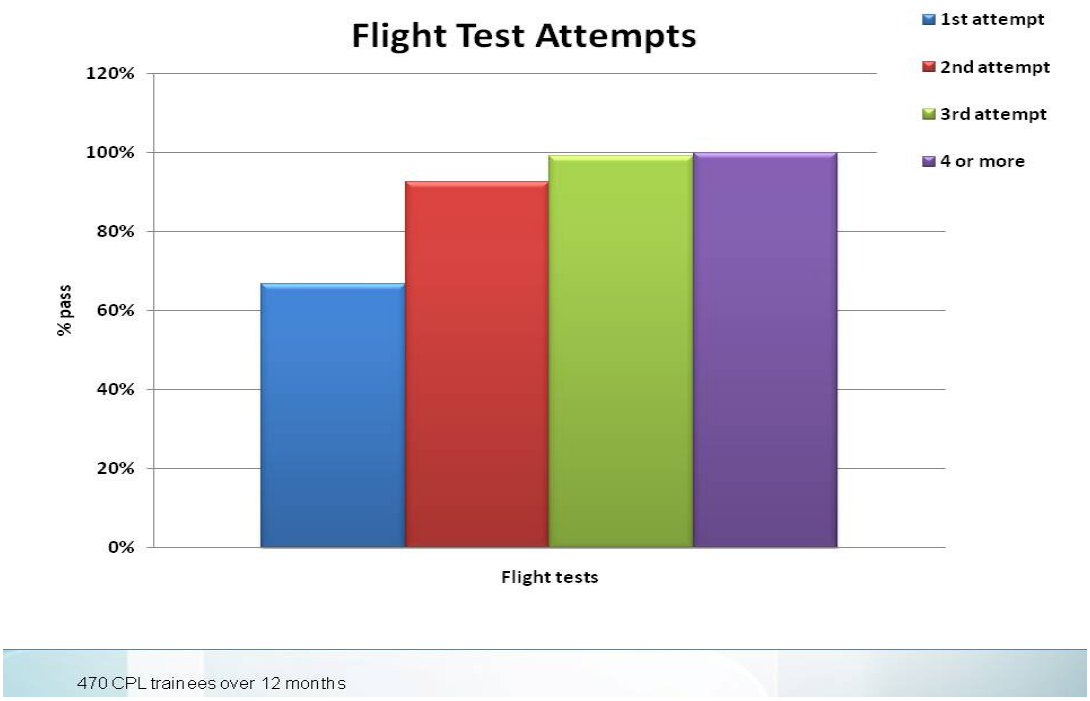

Figure 16 - Pass Rates - Flight Tests (ASPEQ, 2011)

While some restrictions on the resitting of flight tests do exist, and giving due respect to the rights of individuals, it is worth considering the appropriateness of issuing a professional licence which entitles the pilot to carry fare paying passengers under such circumstances.

Future Quantitative Analysis

CAANZ has investigated 374 of the 1967 occurrences reported during flight training in the period 2000 to 2010. CAANZ records the "Cause" for occurrences which are investigated, and these classifications are used in Table 2. The most frequently identified causes for occurrences, which accounted for 62% of the 559 causes identified, are detailed in Table 2.

It is recommended that a detailed analysis be undertaken in order investigate any trends in the contributing factors to flight training occurrences. This was not undertaken for this review as it was determined that the "Causes" identified by CAANZ do not necessarily account for all the contributing factors that lead to the occurrence. For example, Occurrence 10/1207, the Finding was "Did not anticipate effect of prevailing wind" with related Cause "Risk Misperception".

Cause	Frequency
Inadequate checking	67
State change not detected “Information”	61
Actions inconsistent with procedures	35
Poor procedure “Action”	32
Primarily “Structural/Mechanical”	31
Inappropriate “Strategy”	27
Poor instruction/procedures	26
Inexperience (Not lack of training)	24
Inaccurate system “Diagnosis”	22
Inappropriate “Procedures”	22
TOTAL	348

Table 2 - Most frequently identified training occurrence causes, 2000-2010

This singular Cause does not reflect why the Pilot in Command did not anticipate the wind’s effect, which may be attributed to several factors such as poor weather condition reports or a misunderstanding of wind conditions. This example demonstrates why no conclusions have been drawn relating to the trends of all training occurrence investigation findings. A detailed analysis of a selection of occurrences in this Review was deemed more appropriate in order to identify both likely causes of trends in safety performance, and actions or interventions to address the trend causes.

A further investigation to identify more trends in flight training occurrences would be valuable. Possible areas for future analysis include phase of flight, total pilot flying hours, flight rules, occurrence severity, aircraft type, instructor category (for dual training flights) and the level of pilot licence been sought by pilots involved in occurrences. Some of this data is not available directly from CAANZ, and it is suggested that the data set presented in Annex B be used in the future as the basic information CAANZ record and use for analysis of training occurrences. This further analysis will enable possible additional trends to be identified, for example the phase of flight during which a high number of occurrences happen, and subsequently for interventions to be initiated to address the cause of trends.

Determining if there is a link between pilot exam performance and flight training occurrences is an additional area of interest, which may indicate a trend and subsequently actions or interventions that may address this issue.

Another relationship worthy of further investigation is flight instructor experience with respect to the frequency and severity of occurrences. The vital role of the instructor in imparting knowledge and skills as well as the basics of good airmanship to all students is well documented. The funding of flight training is beyond the scope of this review however some factors related to funding can be noted for future reference. Anecdotal evidence suggests:

- There is pressure on instructors to complete training in accordance with a programme linked to the number of hours available under current funding arrangements. Little flexibility is available if remedial training is required.
- Category C instructors (who are usually building up flight hours) are in some instances paid only for hours flown, may not be paid or in some cases are required to pay a fee for their instructional hours, thus leading to a shortening of time spent with the student outside the aircraft.
- This may act as a disincentive for instructors to work with students on pre and post flight briefings and to undertake such tasks as report writing or preparing comprehensive student records.

5.2 Strategic Issues

The flight training sector of aviation activity is an important contributor to the aviation industry as a whole. In addition to providing a pool of pilots who may progress into the public transport area, it provides opportunities for employment and the training of overseas students. The importance of New Zealand's safety record and CAANZ's reputation are noted by Martin Jenkins as key findings:

> *"New Zealand has a good safety record…..The overall trend in the general aviation (GA) sector points to a declining number of fatalities and fewer accidents per 100,000 hour flown although there are some parts of this sector where safety needs to improve."*

> *"Based on the most recent ICAO audit….New Zealand's regulatory framework and regulatory oversight are generally regarded as being in the top tier worldwide."*

In addition to safety benefits, the good reputation that has been established confers important economic benefits for New Zealand… These include ….facilitating the supply by New Zealand based enterprises of aviation services to a worldwide market through having CAANZ approvals recognised and respected by other jurisdictions."

In a recent report Martin Jenkins also notes:

"It is against this background of national importance and potential business opportunities that pilot training needs to be understood."

Knotridge (2010, p. 56) summarise the economic impact of the training sector as a whole (airline, general aviation and engineering) as:

- Domestic revenue $38.5m, "Export" revenue $15m
- Total assets $100m, Number of aircraft 448
- Number of organisations 84, staff employed (FTE) 700, Salary and wages $28m.

Their 2015 forecasts are:

- Conservative : Total revenue $73.3m (Domestic $49.1m, "Export" $24.2m)
- Optimistic: Total revenue $104.8m (Domestic $49.1m, "Export" $55.7m).

At a strategic and national policy level it can be concluded that:

- The flight training sector of the New Zealand aviation industry makes a significant contribution of the economy in terms of income (both domestic and "export") and jobs;
- There is significant potential growth in the sector;
- New Zealand is a respected member of ICAO;
- New Zealand's reputation in world aviation is a significant factor in the viability of the industry; and
- The safety performance of the flight training in particular is critical to continued growth of the sector.

5.3 Regulation of Flight Training

The primary rules governing flight training in New Zealand are Parts 61 (Pilots Licences and Ratings), Part 91 (General Operating and Flight Rules) and Part 141 (Aviation Training Organisations – Certification). As discussed below, Part 141 is only implemented as described below.

Education has a significant role to play in safety in the training sector. CAANZ has been proactive in this area through initiatives such as:

- Flight examiner seminars with an emphasis on "see and avoid"
- Instructor seminars on threat and error management
- Flight Testing guides with emphasis on lookout and terrain awareness
- Vector articles on "see and avoid"
- Education of the industry through Aviation Safety Coordinator courses and
- AVKIWI seminars.

Rule Part 141 Aviation Training Organisations – Certification

Part 141 of the CAANZ Rule Suite prescribes the rules governing the certification and operation of organisations conducting aviation training and assessments. Currently Part 141 requires organisational certification for only a narrow component of the flight training sector and for the assessment of students, instructors and licence holders. Flight test assessment is undertaken as follows:

- Initial issue of CPL, Instrument Ratings and Instructor Ratings are performed by ASL testing officers;
- Flight examiner and renewal of Category A flight instructor ratings are performed by CAANZ officers; and
- Initial issue of PPL and renewal of CPL, Instrument Ratings and Instructor Ratings by a Part 141 (or in some cases Part 119) certificate holder.

The full implementation of Part 141 however requires organisations to also implement:

- Personnel managing the organisation;
- Facility requirements;
- Documentation holdings;
- Training courses and assessments;
- Records and record keeping and

- Internal quality assurance.

The organisation would prepare an exposition describing how the requirements would be implemented in the organisation. They would then be audited against this exposition. While New Zealand does not require Part 141 implementation for training purposes, many leading training organisations have some aspects of quality systems in place.

In summary the adoption of Part 141 for at least organisations training to professional licence standard, would allow regulatory oversight of organisational aspects of flight training.

Rule Part 61

This Part prescribes the requirements for:

- The issue of a pilot licence and rating in accordance with Part 9 of the Act,
- The issue of a rating in accordance with this part,
- The conditions under which a pilot licence is required; and
- The privileges and limitations of a pilot licence or rating.

This part therefore sets out the requirements that a pilot must meet to qualify for a licence or rating. It defines conditions such as flight hours, exams to be passed and competencies to be demonstrated to a flight examiner during a flight test.

An ongoing review by CAANZ of Part 61 contains several initiatives to address shortcomings in testing and examinations.

Rule Part 91

This part prescribes general operating and flight rules for the operation of civil aircraft. It provides the overarching procedures and standards with which pilots must comply to achieve safe operations. It specifies for example fuel requirements, minimum altitudes and the myriad of other conditions for the operation of an aircraft. In particular it should be noted that Part 91.223 specifies that “the pilot of an aeroplane operating in the vicinity of an aerodrome must (1) observe other aerodrome traffic for the purpose of avoiding collision.

The above rules form the core of flight training. They are supported by Advisory Circulars which explain requirements and in New Zealand, an extensive suite of

guides to standards which assist students, instructors and examiners in providing comprehensive, consistent and effective training.

The process for progressing and implementing Rules is understood to be under review through the Ministry of Transport. Any streamlining of the process and in particular the interfaces between the governmental, regulatory and industry participants would assist CAANZ in moving towards more effective and efficient safety regulation.

5.4 Review of Major Accidents

Several major accidents were examined as a sampling exercise to determine whether there were any causal factors which might be systemic to the flight training sector. Caution is required in drawing conclusions due to the small sample size but such an analysis can be useful as a precursor to further work or the development of an industry sector risk profile.

ASL maintains extensive records of exams taken, exam performance, flight tests taken and flight test results. While no conclusions could be drawn from an examination of the examination and flight test data of those involved in the accidents, CAANZ may wish to consider whether a full statistical analysis of the ASL data might be a useful regulatory indicator.

Mid-Air Collision – ZK-MBD and ZK-MBL (09 February 2006)

The two aircraft were involved in a mid-air collision 4.4 km to the north of Shannon (CAANZ, n.d.). Both pilots were completing manoeuvres in preparation for their upcoming CPL flight tests. They had departed Palmerston North airport to engage in general flying exercises in the southern training area. Pilots operating in the training area were required to listen on two frequencies, Palmerston Tower (120.6 MHz) and Massey base operations (133.3 MHz).

From an examination of the report and discussions with CAANZ staff, it was established that possible causal factors might include:

- Position of aircraft in relation to the sun,
- Aircraft blind spots,
- Limitations of un-alerted see and avoid,

- No formal briefing between instructors on the training area being used however, students were briefed that other school aircraft might be operating in the area,
- No procedures were laid down for the maximum number of aircraft which can operate in the area. At the time of the accident, there were two additional aircraft operating in, or transiting, the training area; and
- The report does not mention whether the aircraft made calls while in the training area.

Mid-Air Collision – C152 ZK-ETY and R22 ZK-HGV (17 February 2008)

The C152 (student pilot) reported joining overhead for a standard overhead rejoin for runway 34 (sealed) (Transport Accident Investigation Commission (TAIC), 2009a). The R22 (flight test with examiner on board) transmitted that they were close in to grass runway 34 for a practice autorotation to the centre grass. Witnesses saw the two aircraft converge and collide near the northern boundary of the aerodrome and immediately fall to the ground.

Both aircraft had broadcast their intent however the investigation determined that the 3 pilots were concentrating on flying their aircraft and planning manoeuvres to the detriment of maintaining an effective lookout.
From an examination of the report and discussions with CAANZ staff, it was established that possible causal factors might include:

- Ineffective alerted see and avoid,
- Look out compromised by pilot fixation with flying the aircraft and planning manoeuvres,
- Appropriate radio calls were made but the information was not fully utilised,
- Complex aerodrome geometry with parallel runways and multiple and diverse operations and associated procedures; and
- No coordinated approach to identifying and managing safety risks.

Mid-Air Collision C152s ZK-JGB and ZK-TOD (26 July 2010)

Note. This investigation is still in progress by TAIC.

Both training aircraft were operating from Feilding Aerodrome, the organisation's CFI and her ab-initio students were in ZK-TOD (TAIC, 2010). The solo training student was in ZK-JGB. TOD advised other traffic that they were joining overhead the aerodrome from the north, the student in JGB was crosswind in the circuit vacating to

the training area to the north. The radar records showed that TOD and JGB continued to maintain constant tracks as they closed on each other with TOD maintaining 1300ft and JGB climbing until the aircraft collided. TOD was seen to enter a steep descending spiral dive before impacting the ground and fatally injuring the two occupants. As a result of the collision the engine on JGB stopped however the pilot was able to glide back to the aerodrome. It is inappropriate to pre-empt the TAIC investigation by identifying causal factors.

C152 ZK-KID Impact with Terrain (26 October 2007)

The aircraft was on a cross country air navigation training flight (dual) when it entered a narrow and rising valley (at low level) (TAIC, 2009b). Escape was impossible. As the instructor attempted to manoeuvre out of the valley, the aircraft struck several trees. The instructor was killed and the student suffered serious injuries but was able to walk out and summon assistance.

From an examination of the report and discussions with CAANZ staff, it was established that possible causal factors might include:

- Instructor did not have the training and skills necessary to recognise the dangers associated with flying over mountainous terrain or to make a decision to avoid entering the valley; and
- The low flying leading up to the accident was not approved or justified.

PA 28 ZK-LJB Impact with Terrain near Cass Saddle (16 January 2008)

The aircraft was conducting a cross country training flight with two trainee pilots on board (CAANZ, 2009). The flight was a revision exercise as the PIC was scheduled to complete his CPL cross country flight test the following day. The aircraft was returning to Christchurch from the west coast when it deviated significantly from the authorised flight path and entered a steep valley with rapidly rising terrain from which escape was impossible.

From an examination of the report and discussions with CAANZ staff, it was established that possible causal factors might include:

- Insufficient experience in flying in mountainous terrain at low level; and
- Deviation from his authorised flight planned track.

ZK-EHY – Flight Test Accident – Ruahine Ranges (12 July 2010)

The purpose of the flight was a CPL cross country flight test (CAANZ, 2010). The instructor/examiner allowed the student to enter Pohangina River Valley at a low altitude. Due to a loss of situational awareness causing a navigational error both pilots entered an area of rising terrain. The instructor took control and initiated a forced landing. Both pilots were seriously injured.

From an examination of the report and discussions with CAANZ staff, it was established that possible causal factors might include:

- Situational awareness; and
- Navigation error

Discussion of Mid Air Collisions

The accidents discussed above highlight two causes which the Regulator may consider important. The mid air collisions show the importance of pilots maintaining an effective lookout and a listening watch to provide situational awareness. In addition, the limitations of un-alerted see and avoid must be understood by all pilots (Bureau of Air Safety Investigation (BASI), 1991).

In the TAIC Interim Factual Report (2010) on the mid-air collision at Feilding, the investigator notes on the history of mid-air collisions in New Zealand:

> *"That in the previous collision at Paraparaumu, the pilots of both aircraft had been following recognised procedures and had made radio transmissions at the appropriate time, but did not locate and avoid each other."*

Further, TAIC reviewed CAANZ training data. They noted:

> *"That this data showed that training hours had doubled over the last 15 years to nearly 300,000 hours per year. A review of the accident and incident data showed that the reported number of near misses had increased significantly in the past 5 years. The increase in reported near misses is more pronounced. The total number of near misses for the period 1990 to1999 was 17, with 3 involving training aircraft. For the period 2000 to date, the total number increased to 131, while the number involving training aircraft increased to near 60."*

Three factors emerge, the limitations of see and avoid, the importance of local procedures/airspace design and an increase in the number of near misses reported.

The limitations of see and avoid, and in particular un-alerted see and avoid, are well documented. The Bureau of Air Safety Investigation (BASI) Research Report - 'Limitations of the See-and-Avoid Principle', 1991 and subsequent updates by the Australian Transport Safety Bureau (ATSB), highlight the inherent deficiencies of un-alerted see and avoid. This is not to say that un-alerted scanning should not be used to the contrary this remains a fundamental of good airmanship, but rather that pilots should be aware of the shortcomings and endeavour through the use of radio calls, to increase the effectiveness of visual scanning and improve situational awareness.

Another factor to be considered is the relative experience of the pilot, their situation and overall workload. An inexperienced pilot may well have much of his attention concentrated on handling the aircraft and have less time available to maintain good visual scanning. Also high workload or frequency congestion may impinge on time spent looking outside the aircraft. In congested airspace, it may even be difficult to find an opportunity to transmit on frequency.

Local procedures and airspace design which segregates traffic are important but must be reviewed regularly to reflect changes in facilities and aerodrome operations. As the number of movements increase at an aerodrome or in a training area, the potential for collisions grows. CAANZ and industry participants could consider using the appropriate analytical tool from the range they have available to model and assess each location for solutions which may include:

- Provision of ground based assistance in the detection of potential conflicts through to ground based separation services,
- Changes to the airspace architecture,
- Review of procedures for flight within the area; and
- Memoranda of understanding between multiple users of the airspace.

While the increase in reported near misses at first glance appears of concern, they must be used with caution. A key feature of a progressive safety culture is open and non-punitive reporting. When an organisation adopts such a culture the number of incident reports can climb rapidly – this is a very positive safety outcome as the organisation is more aware of problem areas and can address the issues.

Safety at non-towered aerodromes is not a solely New Zealand issue. In its 2008 report "Safety at Non-Towered Aerodromes" the ATSB concludes:

"However, the actions of individual pilots always dictate the overall safety of operations at these aerodromes." (ATSB, 2008, p. 17)

The ATSB (2008) reiterates the need for pilots to:

- Improve their situational awareness, and ensure awareness of their presence by others using these aerodromes,
- Reduce the frequency of common occurrence types in the vicinity of these aerodromes such as:

    - Ineffective communication between pilots
    - Reduced separation between aircraft
    - Incorrect assessment of other aircrafts' position and intentions
    - Relying on the radio as a substitute for an effective visual lookout
    - Failing to follow published procedures

- Be aware of their responsibilities when operating in the vicinity of non-towered aerodromes by being familiar with non-towered aerodrome procedures.

While the above does not specifically address training operations, as the majority of such operations take place in a non-towered environment, the observations are equally relevant.

New Zealand has a range of tools which can be used to review and optimise operations including an airspace risk model can minimise airspace risks at any given location. The use of the appropriate tool to review airspace design and procedures is valuable at locations where training numbers increase. A final consideration but often overlooked aspect of aerodrome safety is the simplicity of operations. If airspace design is overly complex, or if procedures require pilots to divert much of their attention to navigating the aircraft or changing frequency, any design safety benefits which may accrue from airspace segregation for example, can be offset by the reduction in time that the pilot has available for basic airmanship – looking out and maintaining situational awareness.

Discussion of Mountain Flying Accidents

Mountain flying has its own set of challenges which CAANZ has addressed in recent years. Among the factors to be considered at the flight planning stage are the weather including such effects as updrafts and mountain waves, rotors, and cloud. The height and steepness of the terrain, crossing points of ranges or ridges and the performance of the aircraft at altitude and its ability to turn in restricted spaces are also import factors in planning a route. There are also various illusionary effects to be considered such are scale and false horizons.

Pilots are now required to be trained specifically in this discipline before a licence is issued. CAANZ has undertaken significant pilot education in mountain flying:

- Provided education on mountain flying through the Vector magazine,
- Introduced licencing requirements for instructors providing training in this discipline,
- Mountain flying and terrain awareness is now part of the PPL, CPL and instructor rating syllabus and is required prior to licence issue from 1July 2011,
- Production of Mountain Flying Training Standards Guide,
- Instructor sign off that that mountain flying training has been completed; and
- Publication of booklets and other educational material.

6 Findings

As a result of the safety data analysed as part of this flight training sector review, the following findings are presented to the CAANZ for their internal use and consideration:

1. Recognition that the flight training sector is economically important to New Zealand
2. New Zealand's respected regulatory regime and safety record is a significant factor in selling flight training internationally
3. Part 141 (Aviation Training Organisations – Certification) of the New Zealand Rules set is not implemented for flight training (assessment only). A review of Part 61 contains several initiatives which could improve safety in the flight training sector
4. There are relatively few mid air collisions in New Zealand but when they do occur, they assume a high profile.
5. Instructor and student situational awareness, looking out practices and an understanding of the limitations of "see and avoid" are factors in mid air collisions

6. Airspace design and management are significant factors in minimising risk at non- towered aerodromes and in training areas
7. CAANZ has made significant progress in addressing training (and other) accidents involving mountain flying through education and regulatory (licencing) action
8. Quantitative data on training operations in New Zealand is somewhat inconsistent, and stored in a manner which does not allow easy and flexible access by all stakeholders
9. In the period 2000-2010 there has been an overall increase in the number of occurrences relating to flight training reported to CAANZ from 80 per 100,000 hours in 2000, to 200 occurrences reported per 100,000 hours in 2010.
10. The average fatal accident rate during flight training has increased to be 1.5 per 100,000 hours in 2010, from 0 in 2000.
11. The flight training accident rate is generally flat at 9.0 accidents per 100,000 hours in the period 2000 to 2010.
12. The rate of occurrences resulting in non-fatal injuries during flight training activities has decreased to 1.3 per 100,000 hours, following a spike in 2005 and 2006.
13. The rate of “Airspace Incidents” during flight training has increased significantly since 2005. The reason for this increase may be attributed to the concentration of flight training and the poor use of “see-and-avoid” during flight training.
14. The proportion of “Airspace Incidents” during solo flight training is nearly double the proportion of “Airspace Incidents” during dual flight training. Possible causes of this trend have not been identified as not all occurrences are investigated and subsequently the cause and any trend in the cause, of all “Airspace Incidents” are not available.
15. A minority of CPL students (less than 10%) need more than two attempts to pass examinations and flight tests.

7 Recommendations

As an outcome of this internal review conducted by Aerosafe Risk Management for the internal use by the CAANZ, the following recommendations are provided:

1. CAANZ review the introduction of Part 141 certification for all organisations providing training to professional licence standard. This will strengthen the level of regulatory oversight of the sector as organisations must implement documentation holdings, facility requirements, student records, internal quality systems and other supporting infrastructure within training organisations.
2. CAANZ consider progressing initiatives under Part 61 to strengthen examination and testing requirements.
3. That CAANZ and industry participants consider using further airspace risk modelling (with their range of assessment tools) to minimise risk at congested training locations through airspace design and effective procedures. A goal of simplicity in both airspace and procedure design will maximise the safety impact.
4. That CAANZ examine pass rates in both examinations and flight tests and consider placing requirements for students making multiple attempts to pass such tests.
5. That CAANZ review the reporting of data on flight training to ensure that the data needed for meaningful analysis is available. A review of the fields listed at Annex A and an associated review of the reporting Form 005 may assist in this. A possible schema is attached at Annex B.
6. That CAANZ review their safety data systems with respect to flight training data, particularly to ensure that flexible data analysis is facilitated, and made available to managers or staff in “plain language” and in a format which is useable.
7. That flight training information, as a discrete sector, is specifically and uniquely presented in the CAANZ Safety Report.
8. That CAANZ undertake ongoing quantitative analysis to identify future emerging trends which were highlighted in this review, as described in Section 5.1.
9. That CAANZ undertake further investigation of the possible causes and trends highlighted in analytical sections of this review. Options for achieving this might flow from the updating of reporting mechanisms, a review of the safety investigation process to ensure that primary causes are established and the ongoing reporting by field safety advisors of changes in training activity and other emerging training safety issues.

8 Annex A Requested Data Set

Occurrence Number

Occurrence Date

Occurrence Type Code

Occurrence Descriptor

Severity Factor

Serious Event

Registration Mark

Location

Fatalities

Non-fatal injuries

Nature of Flight

Aircraft Class

PIC Total Flight Hours

PIC Total Hours on Type

PIC Total Hours in last 90 days

Number of PAX (if Solo)

Flight phase

Effect on flight

Flight Rules

Metrological Conditions

Client ID

Approval Unit (i.e. Part 141 Training Organisation or not)

Submitters Name

Findings

Causes

Category

Person/organisation

9 Annex B Possible Data Set – Training Reports

Occurrence Number

Occurrence Date

Occurrence Type Code

Occurrence Descriptor

Severity Factor

Serious Event

Registration Mark

Location

Fatalities

Non-fatal injuries

Nature of Flight

Aircraft Class

PIC Total Flight Hours

PIC Total Hours on Type

PIC Total Hours in last 90 days

Number of PAX (if Solo)

Flight phase

Effect on flight

Flight Rules

Metrological Conditions

Client ID

Approval Unit (i.e. Part 141 Training Organisation or not)

Submitters Name

Findings

Causes

Category

Person/organisation

Instructor Category

Pilot License being sought by Student Pilot

Airspace Delegation

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