A Preliminary Analysis of Fatal General Aviation Accidents in Australia: 1991 to 2000

Executive summary

This Report presents a preliminary analysis of data provided by the Australian Transport Safety Bureau (ATSB) relating to fatal accidents in the general aviation (GA) sector from 1991 to 2000. Cases investigated for the purposes of this Report included all fatal accidents involving Australian registered aircraft, but excluded sports aviation and the small number of fatal regular public transport (RPT) accidents.

A total of 196 fatal accidents which met the above criteria occurred during this period. These resulted in 379 fatalities, divided more or less evenly between pilot and passenger deaths.

On the basis of this preliminary analysis, the tentative findings set out below were made in relation to ***all fatal GA accidents*** considered.

Type of event

- Approximately 43% of these accidents were described as uncontrolled flights into terrain (UFIT). About a quarter of those were associated with low-level flying activities.
- Another 32% involved controlled flight into terrain (CFIT). The majority of these resulted from low-level flying activities.

Sector of operations

- Approximately 53% of fatal accidents and 59% of fatalities resulted from non-commercial flights (i.e. private/recreational flights or those involving personal business).
- Charter activities accounted for 17% of fatal accidents and 22% of fatalities.

Location

- The majority of fatal GA accidents occurred in Queensland and New South Wales, the former being the site of one third of total events.

Contributing or causal factors

- About 38% of fatal accidents were known to have involved problems with flight planning management. While 23% of planning errors were not specified, about a quarter of planning related events involved a VFR rated pilot flying into IMC conditions. Other weather related conditions also figured prominently. In addition, 17% of planning instances referred to unnecessary low-level flying.
- Aircraft handling problems were noted in 30% of fatal accidents.

  Note: The above percentages may significantly underestimate the prevalence of these factors since, in 26% of total fatal accidents, the information was insufficient to allow for reasonable speculation on contributing or causal factors.

In relation to the ***characteristics of fatal GA accidents in specific operational sectors***, the following tentative findings were made:—

Agricultural accidents

- While almost all pilots involved in commercial flights held advanced flying licences, the median hours flown for agricultural pilots was much higher than for those engaged in charter or other aerial work operations.

Private and business accidents

- About 64% of pilots involved in fatal accidents related to personal business flights were over 50 years of age.
- The majority of fatal accidents in the private and business sectors resulted in multiple fatalities.
- Flight planning management problems occurred in 62% and 48% of business and private fatal accidents respectively.

In relation to the ***characteristics of specific types of fatal accidents***, the following tentative findings were made:—

Controlled Flight Into Terrain (CFIT) Accidents

- Equally likely to involve an impact with a tree or other obstacle as with the ground
- 76% involved errors in flight planning management.
- Accounted for all 4 accidents associated with failure to comply with ATC instructions

CFIT accidents resulting from low-level flying

- Almost three quarters involved wire strikes.
- Disproportionately (but not primarily) associated with agricultural work, including mustering.
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Uncontrolled Flight Into Terrain (UFIT) Accidents

- Majority involved impact with the ground (as opposed to trees or other objects).
- 2/3 involved multiple fatalities.
- Pilot age was somewhat younger than average.

UFIT accidents resulting from low-level flying

- Majority involved impact with the ground.
- 90% involved handling problems

Accidents involving Flight Into Terrain (FIT) under partial control

- Approximately one half were fuel related.

1. Background

This analysis is based upon data provided by the Australian Transport Safety Bureau (ATSB), which coded information on all fatal aviation accidents that occurred over the 10-year period 1991 to 2000. The intent of this Report is to both provide an initial high-level descriptive analysis of this data and also to generate hypotheses to be tested in subsequent, more detailed analyses.

2. Data characteristics

2.1 Sample

The data made available by the ATSB referred to all aircraft accidents that:

- occurred between 1991 and 2000;
- involved an Australian registered aircraft; and
- resulted in at least one fatality.

Because this Report focuses on the GA sector exclusively, the three fatal crashes involving RPT flights that occurred during the subject period were not included in the analysis. Sport aviation accidents have also been excluded.

It should be noted that except for the exclusion of these events, no other changes were made to the data. Thus both the general categorization framework and specific classificatory judgments made for individual cases reflected the initial decisions of the ATSB coders.

2.2 Data compatibility with later ATSB studies

In spite of the fact that this report made no changes to the ATSB's coding framework or case specific judgments, it is nevertheless possible that the figures presented in this Report could differ from later ATSB studies based on these data. This could occur due to differences in the sample definitions adopted (e.g. whether subsequent analysis includes accidents involving RPT aircraft), or changes made subsequent to this Report in the data itself (including revision of earlier coding due the discovery of errors).

3. Findings

3.1 Accidents and fatalities

Between 1991 and 2000 a total of 196 fatal accidents occurred which met the criteria established for this study. These accidents resulted in 379 fatalities, with an average of just under 2 deaths per accident.

Of the individuals killed, 188 were aircraft crew members on board the aircraft, 189 were passengers and 2 were crew or passengers killed outside the aircraft.

3.2 Accident type

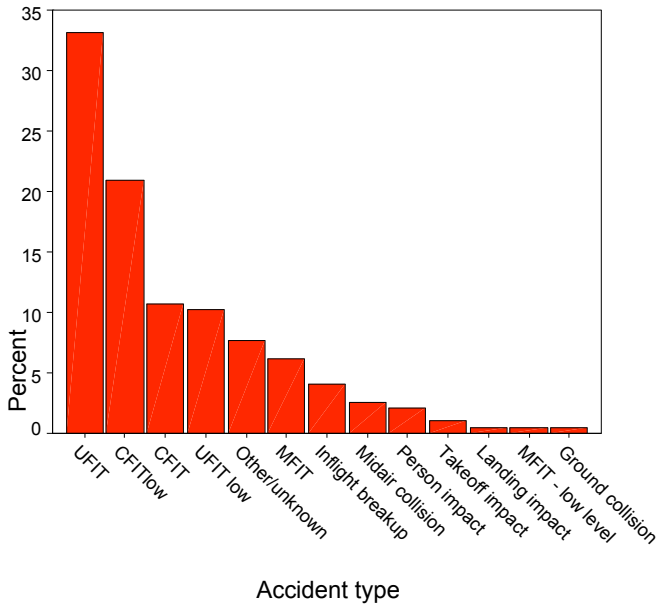
A dominant classification concept used in the ATSB coding framework concerns the extent to which the aircraft was under pilot control. Table 1, below, indicates that 33% of accidents involved an uncontrolled flight into terrain (UFIT) and another 10% of accidents involved UFITs originating from low level flying.[1] Most controlled flights into terrain (CFITs) were due to low flying operations (e.g. agricultural work) with only 11% being CFITs associated with normal high level flying.

In addition, about 10% of accidents involved the aircraft having directional control but suffering some form of capability decrease, designated in the table using the ATSB's acronym, 'MFIT'.

Table 1

Types of accidents involving fatal injuries

	Number of cases	Percent
UFIT	65	33
CFIT: low-level	41	21
CFIT	21	11
UFIT: low-level	20	10
Other/unknown[2]	15	8
MFIT	12	6
Inflight breakup	8	4
Midair collision	5	3
Person impact	4	2
Takeoff impact	2	1
Landing impact	1	<1
MFIT: low-level	1	<1
Ground collision	1	<1
Total	196	100[3]



3.3 Sector of operation

The largest single category of fatal accidents resulted from private flights. With the inclusion of accidents in the business sector[4], it appears that about 53% of fatal accidents and 59% of total fatalities in this sample resulted from non-commercial activity. See Table

[1] References to 'low level' flying in this Report refer to planned flying below 500 feet en-route or manoeuvring.

[2] Includes pilot incapacitation, accidents resulting from theft of aircraft, etc., as well as all cases where no information was available about the nature of the accident.

[3] In this and subsequent Tables, percentage columns may not sum to 100% due to rounding.

[4] Refers to flying associated with a business or profession but not directly for hire or reward.

2.

Table 2
Operating sector of GA aircraft involved in fatal accidents

Operating sector	Cases	% of cases	Fatalities	% of fatalities
Non commercial				
Private	91	46	195	52
Business	13	7	25	7
Sub total	104	53	220	59
Commercial				
Charter	34	17	83	22
Agriculture	25	13	27	7
Other Aerial Work	23	12	35	9
Flying Training	10	5	14	4
Sub total	92	47	159	42
Total	**196**	**100**	**379**	**100**

As the business[5] sector also refers to a category of personal flights, it appears that about 59% of total fatalities in this sample resulted from non-commercial activity.

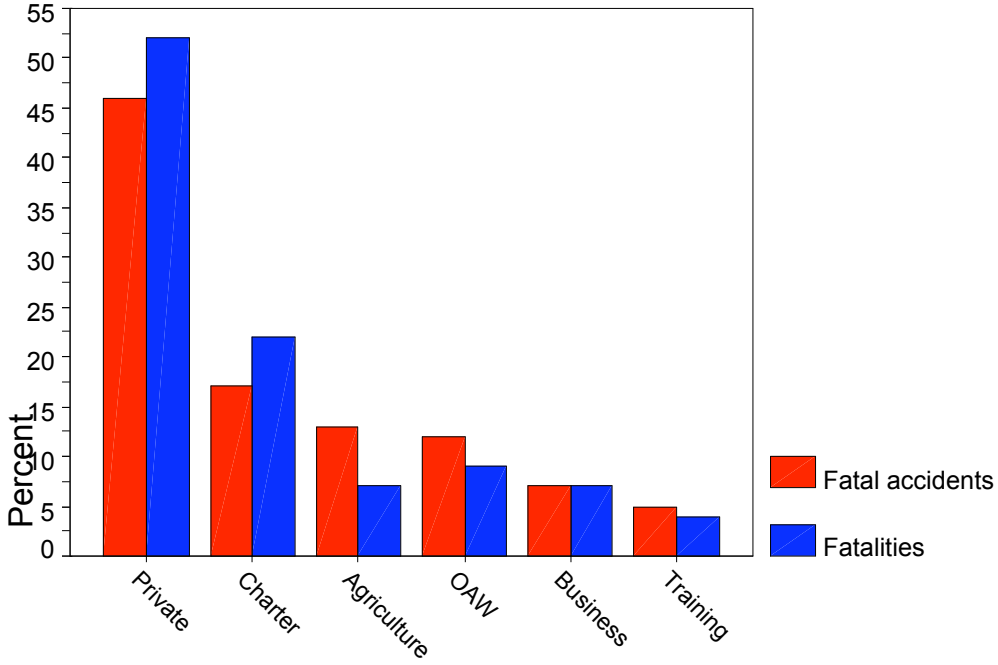
The percentages of accidents and fatalities for various sectors of GA activity are shown in Figure 1.

Figure 1

[5] Refers to flying associated with a business or profession but not directly for hire or reward.

Percent of fatal accidents and fatalities:

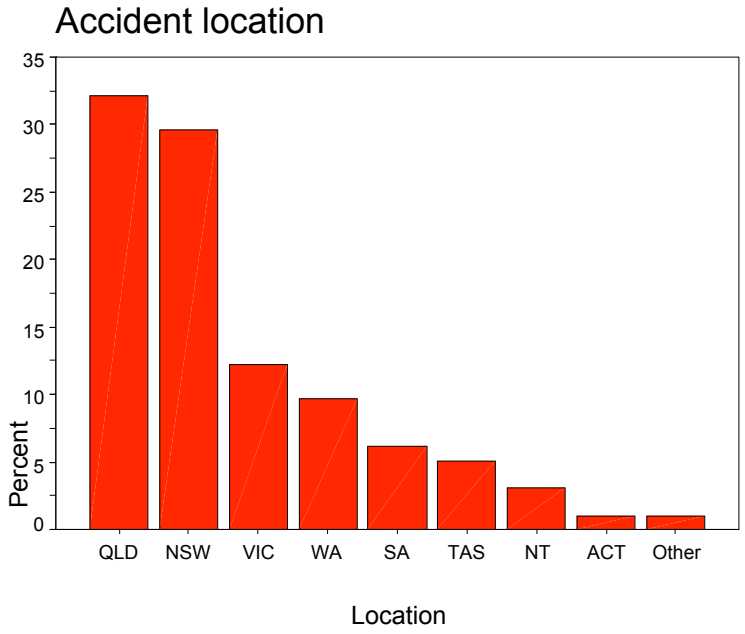
Sectors of operation



3.4 Location of accident

As Figure 2 shows, the clear majority of fatal accidents occurred in just two states: Queensland and New South Wales. The fact that almost one third of fatal accidents occurred in Queensland reflects the disproportionately large amount of GA activity in that state.

Figure 2



3.5 Pilot age

The ages of pilots involved ranged from 19 years to 78 years with an average of age of 43 years. A general distribution of the major age groups involved is shown in Table 3, and a more detailed depiction of that distribution appears in Figure 3.

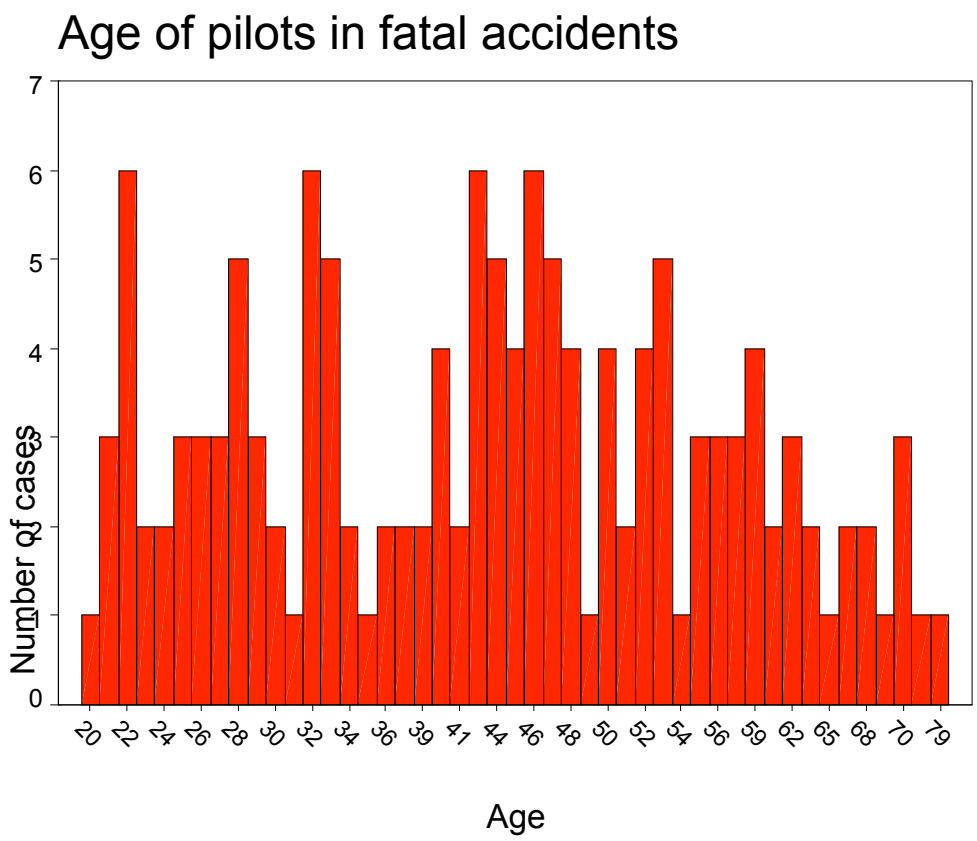
Table 3

Age group of accident involved pilots

Age group	Percent[6]
<31	24
31-40	18
41-50	27
51-60	20
61+	12
Total	100

[6] Age data were not available for almost 30% of pilots. The figures given refer to the percent of cases where this information was available.

Figure 3



3.6 Contributing factors

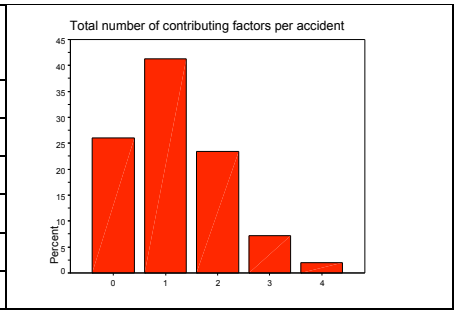
In examining contributing or causal factors, attention was focussed on the identification of opportunities for prevention. An explanation and illustration of the coding approach used is provided in Appendix 1.

It should be noted that, if the same type of factor occurred more than once in a single causal sequence, it was coded on each occasion it occurred. Thus, for example, if two distinct planning errors were made, the accident would be coded as having had two contributing factors.

The number of times contributing factors were noted in various accidents is shown in Table 4.

Table 4
Number of causal factors per case

	Number of cases	% of cases
0	51	26
1	81	41
2	46	24
3	14	7
4	4	2
Total	196	100



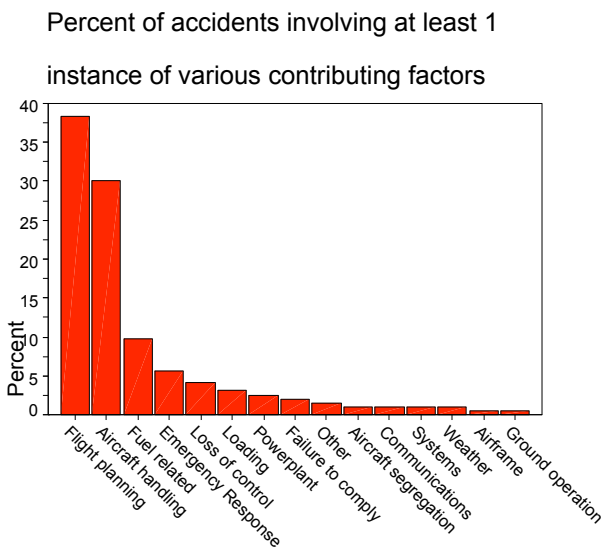
As reflected in the table above, in about 26% of cases there was insufficient information about the event to identify any contributing factors. This lack of information was primarily due to the nature of the crash itself rather than any investigative deficiencies on the part of the ATSB.[7]

Table 5 table records cases where the specified contributing factor appeared *at least once* in the causal sequence leading up to the accident. Thus, although 75 cases involved at least one instance of poor flight planning management, there were 96 individual instances of this factor. This reflects the fact that in some accidents there was more than one separate occurrence of this problem. Similarly there were 70 separate instances of handling problems.

Table 5

Involvement of particular contributing or causal factors

Contributing factors[8]	**No. of cases**	**% Total**[9]
Flight planning management	75	38
Aircraft handling	59	30
Fuel related	19	10
Emergency Response	11	6
Loss of control/performance	8	4
Loading	6	3
Powerplant	5	3
Failure to comply	4	2
Other	3	2
Aircraft segregation	2	1
Systems	2	1
Communications	2	1
Weather	2	1
Ground operations	1	<1
Airframe	1	<1



It appears that only a small number of contributing or causal factors were involved in most accidents. The most predominantfactors are *flight-planning management* and the *inadequate handling of the aircraft*. The particular types of errors made in respect of each recorded instance of these two factors are shown below in Tables 6 and 7, respectively.

[7] The amount of investigation effort expended on each event is categorized on a scale from 1 to 5, with category 5 events not receiving any significant investigation. The percentages of accidents in this sample assigned to receive specified levels of investigation were as follows: (1) 0%, (2) 10%, (3) 57%, (4) 29% and (5) 5%.

[8] Definitions of these descriptions appear as Table 10 in Appendix 2.

[9] The percentages specified are necessarily underestimates, since in about 26% of total accidents there was insufficient information to comment on causal factors. Thus, while inadequate flight management was noted at least once in 38% of *total* cases, this corresponds to about 44% of cases where there was information about causal factors.

Table 6

Type of flight planning management error[10]

Error type	Percent
VFR into IMC	25
Unknown/other	23
Unnecessary low level flight	17
Weather induced low flying	11
Emergency response decision	9
Approach beyond minima	4
NVFR in dark conditions	4
VFR after last light	4
IFR visual into IMC	2
Total	100

While about 23% of planning errors were not specified, it can be seen that about a quarter of the total instances involved a VFR rated pilot flying into IMC conditions. Other weather-related conditions also figure prominently. In addition, 17% of instances referred to unnecessary low-level flying.

Table 7

Type of handling error

Error type	Percent
Mishandling	59
Pilot response to emergency	19
Incorrect configuration[11]	13
Unnecessary maneuver (with higher risk)	9
Interference with aircraft	1
Total	100

While most of the 'mishandling' errors probably related to inappropriate skill levels, many of the other handing events are likely to contain some element of inappropriate judgment.

4. Characteristics of accidents in specific operating sectors

Differences between fatal accidents in various sectors of GA operation are examined in this section.

[10] 96 occurrences in 75 accidents.

[11] Inappropriate selection of settings for flaps, landing gear, etc. for particular phase of flight.

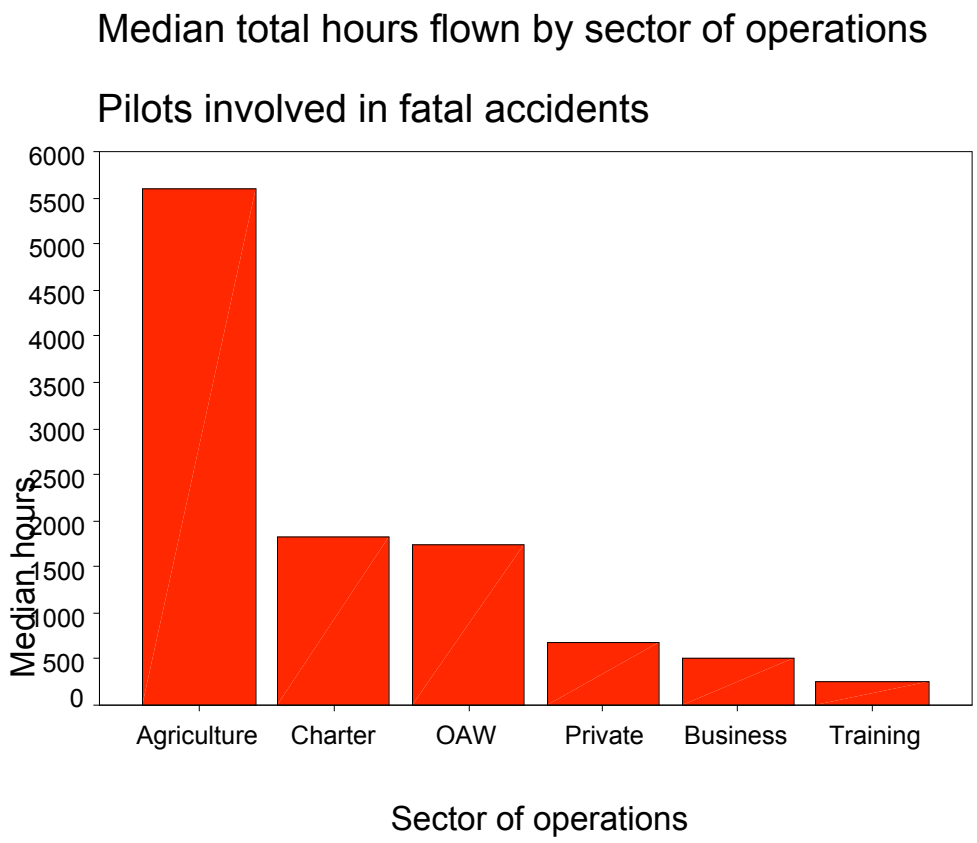
4.1 Pilot flying experience

As expected, virtually all pilots involved in commercial activities (i.e. agriculture, charter, and other aerial work) held advanced flight crew licences (i.e. a commercial pilot licence (CPL) or an air transport pilot licence (ATPL)). Within this group, the median hours flown by agricultural pilots was much greater than the others. For example, whereas about 30% of CPL or ATPL holders in the charter or 'other aerial work' (OAW) sectors had flown more than 4600 hours, this figure was 57% for agricultural pilots.

About 30% of the pilots of private flights involved in fatal accidents held an advanced licence compared with only 8% of the 'business' pilots.

The median[12] total hours flown by pilots in various sectors is shown in Figure 4 (below).

Figure 4



In terms of the median total hours flown, there were significant differences among the following four groups: agricultural work, charter and other aerial work, private and business, and flying training.

[12] The median is the point at which 50% of scores lie above it. It is a more accurate measure of central tendency than the arithmetic average when, as in this case, distributions are highly skewed.

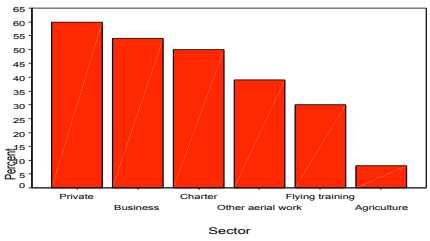
4.2 Multiple fatalities

As shown in Table 8 (below), agricultural fatal accidents rarely involved more than a single death, whereas the majority of business and private fatal accidents resulted in multiple fatalities.

Table 8

Percentage of fatal GA accidents resulting in multiple fatalities (by sector)

Sector	Percentage
Private	60
Business	54
Charter	50
Other aerial work	39
Flying training	30
Agriculture	8



4.3 Pilot age

About 64% of pilots in the business sector were over the age of 50 compared with about 31% overall.

4.4 Contributing factors

As shown in Table 9 (below), problems with flight planning were noted most frequently in the case of fatal accidents involving private and personal business flights.

Table 9

Percentage of accidents involving flight planning and management problems

Sector	Percentage
Business	62
Private	48
Charter	44
Other aerial work	22
Agriculture	12
Flying training	0
Average	38

5. Characteristics of certain accidents types

In this section, certain characteristics of the 5 most common types of GA fatal accidents are considered: UFITs (normal and low-level flying), CFITs (normal and low-level flying), and FITs under partial control, designated as 'MFIT'.

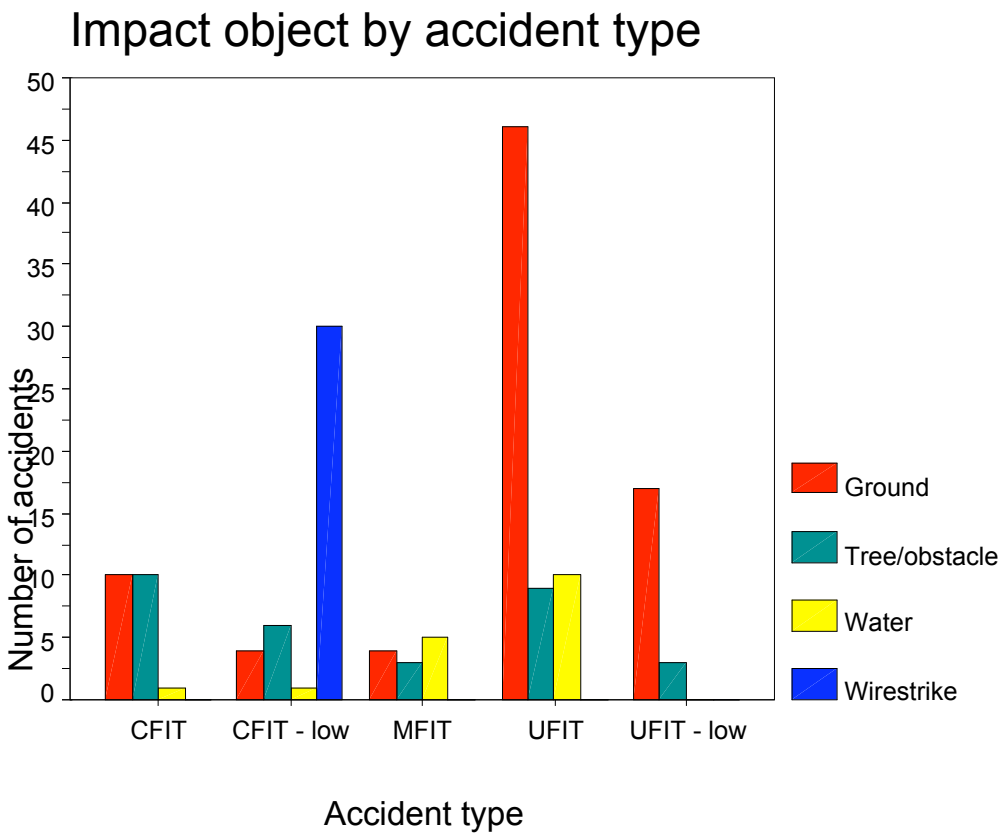
5.1 Object hit

As indicated in Figure, in both UFITs and low-level UFITs, the vast majority of accidents involved a ground impact. In the case of low-level CFITs, however, almost three quarters of

fatal accidents involved wire strikes. It should be noted that all wire strikes were, by definition, coded as low-level CFIT events.

CFITs were equally likely to involve an impact with a tree or other obstacle as with the ground, and 5 of the 12 MFITs involved impact with water.

Figure 5



5.2 Contributing factors

About 76% of the CFIT accidents considered involved an error in flight planning. There was evidence of handling problems in 90% of low-level UFIT accidents.

Half of the MFIT accidents reviewed were fuel related and all 4 accidents where there was a failure to comply with ATC instructions resulted in a CFIT.

5.3 Sector of operations

CFITs resulting from low-level flying were disproportionately associated with agricultural work (68% of agricultural accidents were of this type, compared with 26% for the entire sub-sample). Nevertheless, only 37% of total low-level CFIT accidents involved agricultural work.

5.4 Multiple fatalities

Only about one third of the low-level accidents considered resulted in multiple fatalities. In part, this reflects the fact that agricultural aircraft are disproportionately involved in low-level accidents and rarely carry passengers when engaged in agricultural operations. About two thirds of all UFIT accidents considered involved more than one fatality.

Appendix 1

The coding of contributing factors

Rather than describing a comprehensive causal chain for each accident, the coding of contributing factors focussed on identifying opportunities for intervention. For this reason, a factor was recorded for every event or action that:

1. was inadequate or inappropriate to the circumstances;

2. was not inevitable under the circumstances (i.e. things could have been otherwise); and

3. increased the chances that the accident occurred and/or led to fatalities.

The following example illustrates this kind of approach:

1. A helicopter pilot deliberately takes off for a remote location with inadequate fuel his aircraft tanks for the journey. Instead he carries carrying additional fuel on board in cans. He plans to set down at particular sites en-route and fill up the aircraft from these cans instead of planning a route that would have allowed appropriate refueling at airports en-route.

2. En-route, his instruments indicate that fuel exhaustion is imminent but he continues with his flight.

3. Fuel exhaustion occurs and the aircraft loses power.

4. A decision is made to perform an autorotation landing.

5. The autorotation landing is not performed adequately.

6. The pilot loses control of the aircraft and there is a violent impact with the ground.

7. The on-board fuel cans explode.

8. Fatalities result from the burning fuel.

In the above accident, only 3 intervention opportunities existed: stage 1 (planning), 2 (planning), and 6 (handling). Stages 3, 6, 7, and 8 follow fairly directly from previous stages with little chance that things could have been different, and therefore do not meet criterion 2. Stage 4 was an appropriate decision and therefore does not meet criterion 1.

Appendix 2
Description of contributing factors

Table 10

Contributing factors	Description
Flight planning management	Refers to information acquisition, processing and decision-making, both before and during the flight. It contemplates a wide range of instances including unnecessary low level flight, VFR after last light, VFR into IMC, etc.
Aircraft handling	Refers to inappropriate execution of flight planning decisions. Mishandling of the aircraft including unnecessary maneuvers and inappropriate emergency responses.
Fuel related	Fuel contamination, exhaustion, and starvation.
Emergency Response	Response by ATC or RFFS as well as cabin preparations
Loss of control/performance	Loss of control or loss of performance whether in flight or on the ground
Loading	Weight and balance
Powerplant	Propulsion loss, whether full or partial, real or perceived.
Failure to comply	Failure to comply with ATC, or published approach procedures.
Other	Includes bird or animal strikes, crew illness or incapacitation, intentional damage, and inaccurate metrological information.
Aircraft segregation	Excludes all cases with ATC involvement.
Systems	Aircraft systems including fuel, instrument air power, and pressurization.
Communications	Incorrect/inadequate traffic information from ATC or inadequate pilot communications OCTA
Weather	Icing, turbulence, and windshear or thunderstorm
Ground operations	Ground handling, jet blast, near collision on ground with aircraft or vehicle, propeller strike, or runway incursion
Airframe	Includes, doors, fuselage, landing gear, wings, etc.