Australian Government
Australian Transport Safety Bureau

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ATSB Aviation Safety Survey – Common Flying Errors

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EXECUTIVE SUMMARY

The aim of this study was to provide information to the flying community concerning those common errors they perceived to be most detrimental to flight safety. The ATSB sent the ‘Aviation Industry Safety Survey’ to 5000 commercial pilots throughout Australia in November 2003. The survey asked pilots about their safety experiences during the previous year and to report the most serious error they made or saw during that time. They were also asked to describe briefly what they thought were the main factors contributing to the error and how the situation was recovered.

Demographic information concerning pilot age, highest licence qualification held, and type of aircraft flown (rotary or fixed wing) was obtained. Pilots were grouped according to the flying category they most frequently worked in the 12 months preceding the survey: regular public transport, charter, aerial work or private operations. Slight differences were evident among the four flight categories with regard to each of the demographic groups.

Pilots’ open-ended responses were analysed and seven error categories were determined. These were: the location at which the error occurred; the primary type of error; the primary and secondary contributing factor; the primary and secondary defence recovering the error; and the implementation of any post-event defences designed to prevent recurrence. Descriptive statistics and cross-tabulations for each error category by flying category are presented in the main paper.

Some caution is required when interpreting the results because considerable amounts of data were missing. Overall, approximately 40% of pilots who responded to the survey elected not to provide a response to this question. Distinct differences between this group and those providing such information may have existed. Accordingly, these results may not be representative of the wider flying community. For this reason, rigorous statistical analyses could not be performed comparing the four flying categories (i.e., whether there were statistically significant differences among the four flying categories across each of the error characteristics).

Results indicated that the majority of errors across all flight categories occurred en route, distantly followed by flight preparation. Similarities were also found among the flight categories in terms of primary error type (e.g., procedural – en route and data misprocessing – from operating environment); primary and secondary contributing factor (e.g., lack of experience); and defence (e.g., no defence, pilot skills and procedures). The majority of respondents reported an incident in which they were directly involved. This increased the likelihood that results reflect those unsafe acts of concern in the operational environment. Although third party information is invaluable to enhancing flight safety, it is often limited (e.g., are key factors identified).

Main findings – Across all flight categories

Human error is to be expected in any complex activity, not only by those directly operating the system (e.g., pilots) but also those performing managerial, design and regulatory roles. The following results do not suggest that aviation is more at risk from error than other activities. Nor do they compare results across the different transport modes.

- Results indicated that 11.8% of events involved the violation of standard operating procedures
- Wilfully risky activities were present in 3.2% of error events
- Overall, 2.1% of reported occurrences resulted in an accident
- Results indicated that 9.1% of respondents were involved in a concern relating to a mid-air collision, most of which involved no warning (unalerted confliction 6.1%)

Main findings – RPT specifically

- The most frequently identified primary error type was procedural errors – en route, followed by misconfiguration, mishandling, data misprocessing – navigation, and data misprocessing – from operating environment
- The primary contributing factors identified were fatigue, workload – individual level, experience, systems procedures – do not ensure safety, and systems – equipment
- The primary defences identified were procedures, pilot skills, redundant information systems, and third party notification – flight crew. In some cases no defence existed to assist error recovery.

INTRODUCTION

The ATSB Aviation Safety Survey - Common Errors

In November 2003, the ATSB distributed the Aviation Industry Safety Survey to pilots registered on the pilot licence register maintained by the Civil Aviation Safety Authority (CASA). The sample consisted of 5000 Australian Transport Pilot Licence (ATPL) and Commercial Pilots Licence (CPL) holders with current medical certificates. The names and addresses were supplied by CASA under a confidentiality agreement with a mail distribution service that conducted the survey mailout. At no point was the identification and addresses of respondents made known to the ATSB. Nor were pilots survey responses made known to CASA.

The survey was designed to ask operational personnel about their perception of safety in their workplace and comprised two sections. The first, Part A, investigated safety climate and consisted of questions regarding management commitment, training, equipment and maintenance, rules and procedures, communication and work schedules. This section has been analysed and documented in a separately published ATSB report. For information regarding the safety climate component of the survey, please refer to the 'ATSB Aviation Safety Survey – Safety Climate Factors' report. The second, Part B, asked respondents about their flying experiences in the 12 months prior to the survey. Although Part B included nine questions, only those answers referring to question 45 (a, b & c), requesting information on an error or incident have been addressed in this report.

This report focuses on those errors and/or violations reported by pilots based on the most serious error they had made or seen in the 12 months preceding the survey. Most of the responses describe errors attributed to human action that have been either exacerbated or mitigated by the organisational environment in which they occurred. This report therefore conveys the opinion of industry and not the opinion of the ATSB. However, standard analytical methodology has been applied to the best extent possible. For detailed information regarding contributory factors in occurrences, please refer to Appendix A.

Survey Information

In total, 1263 respondents completed Part B of the survey, representing a response rate of 25 per cent. Of these responses 353 (28.0%) were engaged in regular public transport operations, 204 (16.2%) were involved in charter work, 330 (26.1%) in aerial work and 323 (25.6%) conducted private operations. Overall, 53 (4.2%) of responses could not be used because they were completed by military personnel, those engaged in business or were missing information.

However, with regard to question 45 (a, b, & c) specifically, substantial amounts of potential data were lost due to non-completion (N=727, 60.1%)[1]. The remaining sample was divided as follows: 205 for RPT (58.1%), 126 for charter (61.8%), 211 for aerial

[1] N refers to the number of usable responses relating to a particular section

work (63.9%) and 185 for private operations (57.3%). In addition, some details were missing in respondents' answers, reducing the amount of information further. This influences Section 3 onwards in the report. Caution must therefore be taken when interpreting these findings as they may not accurately represent experiences of the wider flying community. That is, distinct differences may have existed between the experiences of those electing to complete this section and those who did not.

METHOD

Question 45 was as follows: 'Everyone sometimes makes mistakes. Most errors have little impact on safety, but others are significant. To help us to understand the common errors that occur in normal flying operations, please tell us about the most serious (or most risky) error you made or saw during the last 12 months. Please also briefly describe what you think were the main factors contributing to this error and how the situation was recovered'.

A content analysis was conducted to convert the pilot written response data into a format conducive to statistical analyses. Elements for each of the categories were determined via analysis of the first fifty commercial cases by three ATSB personnel. One of these holds an ATPL licence with nine years flying experience, including turboprop, multicrew and training experience across a wide range of aircraft. Another is a qualified pilot with an aeronautical engineering degree and the third, a transport safety investigator in the field of human performance. Content analysis of the remaining cases was completed by two personnel and inter-rater reliability determined. Disagreement was reconciled through discussion, and consultation with the third individual when it was necessary.

Overall, location of error was separated into four groups: en route; flight preparation; air traffic services (ATS); and non flight. Each group had an associated primary error. En route errors were separated into twelve groups (e.g., mishandling, misconfiguration); flight preparation into six (e.g., data gathering, procedural – flight preparation); ATS into three (e.g., misidentification, traffic confliction); and non flight into three primary error groups (e.g., maintenance, unqualified). Further analysis identified 28 primary and secondary contributory factors. These were aspects of the situation that enhanced the likelihood of an error (e.g., fatigue, commercial pressure). Aspects that assisted error recovery or prevented further deterioration were also identified. Twenty defences were identified and examples included pilot skills, conservative practices, etc. Finally, seven post-incident defences were identified (e.g., further training, installation of equipment). See Appendix B for a complete list, definitions and survey examples.

DEMOGRAPHIC INFORMATION OF AUSTRALIAN PILOTS

Representation of flying categories

Information regarding the flying category in which respondents engaged most in the previous 12 months was collected. Inspection of Table A indicates that the primary type of flying in which respondents were involved was regular public transport (RPT), followed by private flying. A large number of respondents were also involved in passenger-carrying charter operations and aerial work training others to fly. To simplify analyses, categories were aggregated into four groups comprising RPT; charter (charter passenger and charter other); aerial work (emergency or medical services, agriculture, surveying or spotting, flying training and aerial work - other); and private operations. Inspection of the private operation data indicated that some respondents (N=50, 15.5%) had indicated another flying category (e.g., aerial work – other) as that category of flying they did most of the time in the previous 12 months. In such cases, respondents were classified under the higher order category of private operations and analyses were based on this (see Table 2 for the aggregated categories). Comparison of frequency of responses with flying category data contained in the ATSB Aviation Safety Survey – Safety Climate Factors and the current report indicate slight discrepancies. This is due to the nature of data supplied in Part A and Part B of the survey. As stated previously, there was a considerable amount of missing data.

Table 1: Responses per flying category

Flying Category	Frequency	Per cent
RPT	353	27.9
Charter - passenger	182	14.4
Charter - other	22	1.7
Aerial work - emergency or medical services	58	4.6
Aerial work - agriculture	42	3.3
Aerial work - surveying or spotting	28	2.2
Aerial work - flying training	151	12.0
Aerial work - other	51	4.0
Business	20	1.6
Private	323	25.6
Military	4	0.3
Sub Total	1,234	97.7
Missing information	29	2.3
Total	1,263	100.0

NB: Small rounding errors may exist in this table and subsequent tables.

Table 2: Responses per aggregated flying category

Flying Category	Frequency	Per cent
RPT	353	29.2
Charter	204	16.9
Aerial	330	27.3
Private	323	26.7
Total	1,210	100.0

Age distribution of Australian pilots

Information regarding respondent's age was collected (see Table 3). Of the 1210 surveys, 1199 were used to calculate frequencies (i.e., response rate of 99.1%). Eleven cases did not provide information regarding either age or flying category. Pilots in the RPT group ranged in age from 24 to 66 years (M = 46.36, SD = 9.75)[2]. Charter pilots ranged in age from 19 to 78 years (M = 44.85, SD = 12.70). The age range of aerial work pilots was 20 to 77 years (M = 47.98, SD = 12.52). Private operations pilots ranged in age from 19 to 82 years (M = 52.99, SD = 13.64).

Table 3: Pilot age by flying category

Age Range		RPT	Charter	Aerial work	Private operations	Total
Under 29	Count	17	31	26	19	93
	%	**4.8**	**15.2**	**7.9**	**5.9**	**7.7**
30-39	Count	74	41	65	36	216
	%	**21.0**	**20.1**	**19.7**	**11.1**	**17.9**
40-49	Count	105	40	80	61	286
	%	**29.7**	**19.6**	**24.2**	**18.9**	**23.6**
50-59	Count	134	69	92	93	388
	%	**38.0**	**33.8**	**27.9**	**28.8**	**32.1**
60-69	Count	20	16	56	76	168
	%	**5.7**	**7.8**	**17.0**	**23.5**	**13.9**
70 & Over	Count	0	4	10	34	48
	%	**0.0**	**2.0**	**3.0**	**10.5**	**4.0**
Missing Information	Count	3	3	1	4	11
	%	**0.8**	**1.5**	**0.3**	**1.2**	**0.9**
Total	Count	353	204	330	323	1,210
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Flying qualifications

Table 4 represents the highest level of pilot licence qualification held by respondents in each of the four flight categories (N=1210). Categorisation could not be determined for one respondent. The finding that 12.7% (N=41) of pilots identified the PPL as their highest qualification was unexpected as the sample involved only those with CPL or ATPL licences. It is possible that respondents misinterpreted the question and identified themselves as private pilots based on the status of their current medical. At present, a Class 1 medical (required for commercial operations) remains in force for one year, whereas a Class 2 medical (required for private operations) remains in force for four years for a pilot who is less than 40 years old at the time of issue, or for two years for a pilot who is 40 years or older at the time of issue[3]. The assessment for a class 1 medical is more stringent, therefore it is also considered to meet the requirements for a class 2 medical. A commercial pilot may therefore conduct private flight operations on the

[2] M = Mean, SD = Standard Deviation
[3] Civil Aviation Safety Regulations (1998), part 67.205

strength of a class 1 medical that is more than one year old if it falls within the period of force for a class 2 medical.

Table 4: Flight category by highest licence qualification held

Licence type		RPT	Charter	Aerial work	Private operations	Total
PPL	Count	0	0	0	41	41
	%	**0.0**	**0.0**	**0.0**	**12.7**	**3.4**
CPL	Count	12	117	208	236	573
	%	**3.4**	**57.6**	**63.0**	**73.1**	**47.4**
ATPL	Count	341	86	122	46	595
	%	**96.6**	**42.4**	**37.0**	**14.2**	**49.2**
Total	Count	353	203	330	323	1,209
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Representation of aircraft flown

Table 5 represents the type of operation predominantly flown by respondents in the 12 months preceding the survey. Pilots were again selected on the basis of belonging to either of the four flight categories. Of the 1210 surveys, 1150 were classified as either fixed wing or rotary. Categorisation could not be determined for 60 respondents. The majority of pilots indicated they had mainly flown fixed wing aircraft in the 12-month period. Aerial and charter work (23.6% and 18.0%, respectively) involved higher use of rotary aircraft than RPT or private, due to the nature of their work (e.g., mustering, isolated areas, medical, etc). However, this was lower than those using fixed wing aircraft.

Table 5: Flight category by type of aircraft flown

Aircraft Type		RPT	Charter	Aerial work	Private operations	Total
Fixed wing	Count	333	155	239	290	1,017
	%	**99.4**	**82.0**	**76.4**	**92.7**	**88.4**
Rotary	Count	2	34	74	23	133
	%	**0.6**	**18.0**	**23.6**	**7.3**	**11.6**
Total	Count	335	189	313	313	1,150
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

INCIDENT CHARACTERISTICS

Human error is to be expected in any complex activity, not only by those directly operating the system (e.g., pilots) but also those performing managerial, design and regulatory roles. The following results do not suggest that aviation is more at risk from error than other activities. Nor do they compare results across the different transport modes.

Involvement in flight error

A distinction was made between error events that were reported by individuals directly involved in making an error and those who witnessed an error made by another pilot (see Table 6). To be categorised in the former category, respondents either made the error themselves, were part of the crew involved in making the error or were directly affected by the error made by another (e.g., unalerted see and avoid). The latter category consisted of responses from those who witnessed the event but were not directly influenced by it (e.g., saw an aircraft handled badly which posed no immediate risk to themselves). Results indicated that of the 727 valid cases (60.1%), 87.1% reported on an incident in which they were directly involved. A further 9.5% of the sample reported on an incident they witnessed.

Table 6: Flight category by involvement in flight error

Level of Involvement		RPT	Charter	Aerial work	Private operations	Total
Directly involved in occurrence	Count	181	107	177	168	633
	%	**88.3**	**84.9**	**83.9**	**90.8**	**87.1**
Witnessed occurrence	Count	12	17	23	17	69
	%	**5.9**	**13.5**	**10.9**	**9.2**	**9.5**
Could not be determined	Count	12	2	11	0	25
	%	**5.9**	**1.6**	**5.2**	**0.0**	**3.4**
Total	Count	205	126	211	185	727
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Violation presence in error sequence

Analyses of respondents' information also identified the presence or absence of a violation during the nominated event (see Table 7). Results indicated that 11.8% (N=86) of events involved the violation of standard operating procedures. There appears to be a higher level of violations occurring in charter, aerial work and private operations than in RPT. An example of a violation included company pilot knowingly taking off overweight, IFR flight in a NVFR aircraft, landed in 30-knot crosswind (aircraft maximum 25-knot), etc.

Table 7: Flight category by existence of a violation

Violation		RPT	Charter	Aerial work	Private operations	Total
Violation occurred	Count	12	17	27	30	86
	%	**5.9**	**13.5**	**12.8**	**16.2**	**11.8**
No violation occurred	Count	193	109	184	155	641
	%	**94.1**	**86.5**	**87.2**	**83.8**	**88.2**
Total	Count	205	126	211	185	727
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Presence of wilfully risky activity during error sequence

Events involving a pilot taking an unnecessary risk were also identified. Results indicate that 3.2% (N=23) of error events involved wilfully risky activities (see Table 8). Examples of wilfully risky activities include: strong desire to return to base whilst exceeding duty hours and under deteriorating weather and failing light conditions; flying below LSALT whilst VMC, in mist and low cloud; take off in high temperatures, normal weight and reduced climb performance; etc.

Table 8: Flight category by wilfully risky activities

Risk Taken		RPT	Charter	Aerial work	Private operations	Total
Wilfully risky	Count	2	2	10	9	23
	%	**1.0**	**1.6**	**4.7**	**4.9**	**3.2**
No risk taken	Count	203	124	201	176	704
	%	**99.0**	**98.4**	**95.3**	**95.1**	**96.8**
Total	Count	205	126	211	185	727
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Error event resulting in accident

Responses were analysed to determine whether an accident occurred (see Table 9). An accident was defined in terms of damage to the aircraft requiring either extensive repairs or replacement, according to ICAO definition, Annex 13 chapter 1. Overall, 2.1% (N=15) of reported occurrences resulted in an accident. Examples include: wire strike; crashing on runway; etc.

Table 9: Flight category by accident involvement

Accident		RPT	Charter	Aerial work	Private operations	Total
Accident occurred	Count	0	2	8	5	15
	%	**0.0**	**1.6**	**3.8**	**2.7**	**2.1**
No accident occurred	Count	205	124	203	180	712
	%	**100.0**	**98.4**	**96.2**	**97.3**	**97.9**
Total	Count	205	126	211	185	727
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Error event involving near mid-air collision

Analyses also determined the presence of near mid-air collisions and the presence or absence of factors assisting pilots' response to them (see Table 10). Results indicated 9.1% (N=65) of respondents were involved in a mid-air collision concern and the majority of these involved no warning (unalerted confliction 6.1%, N=44). Examples of mid-air collision concerns included: near miss – accepting position information by inbound aircraft as accurate; prompt response to TCAS; intervention by ATC; etc.

Table 10: Flight category by mid-air collision concern

Mid- Air Fright		RPT	Charter	Aerial work	Private operations	Total
Unalerted	Count	4	12	18	10	44
	%	**2.0**	**9.5**	**8.5**	**5.4**	**6.1**
Pilot radio	Count	2	1	1	1	5
	%	**1.0**	**0.8**	**0.5**	**0.5**	**0.7**
ATS radio	Count	2	0	0	2	4
	%	**1.0**	**0.0**	**0.0**	**1.1**	**0.6**
TCAS	Count	10	0	2	0	12
	%	**4.9**	**0.0**	**0.9**	**0.0**	**1.7**
No mid-air fright	Count	186	112	188	172	658
	%	**90.7**	**88.9**	**89.1**	**93.0**	**90.5**
Category could	Count	1	1	2	0	4
not be determined	**%**	**0.5**	**0.8**	**0.9**	**0.0**	**0.6**
Total	Count	205	126	211	185	727
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

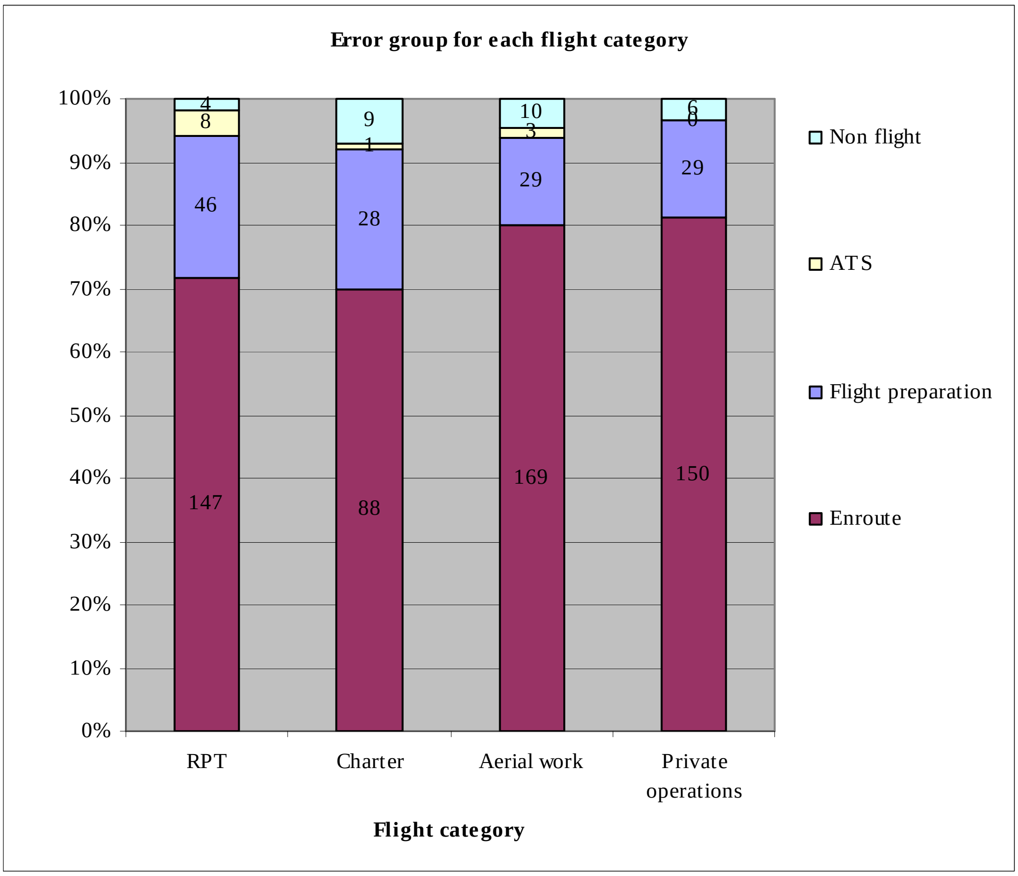
ERRORS IDENTIFIED BY PILOTS

This section provides frequency information regarding the errors nominated by pilots. It addresses the error itself, the factors that contributed to the error, and those factors that helped recover the situation (when recovery was possible).

Error group across the flight categories

To determine where the majority of errors occurred, a cross-tabulation was conducted comparing flight category and the location at which errors occurred (error group). Figure 1 displays these results (N=727). Inspection indicates that the vast majority of errors, regardless of flight category, occurred during flight (en route - error occurred whilst executing in-flight activities), followed distantly by flight preparation (error occurred during preparation activities for the next flight and may occur due to failure to identify and correct an error completed by the previous pilot). Very few errors identified by pilots resulted from actions external to the flight crew (i.e., air traffic service(s) or those involved in non-flight activities such as maintenance). Appendix C provides details for all flight categories and error locations.

Figure 1: Four error groups according to flight category



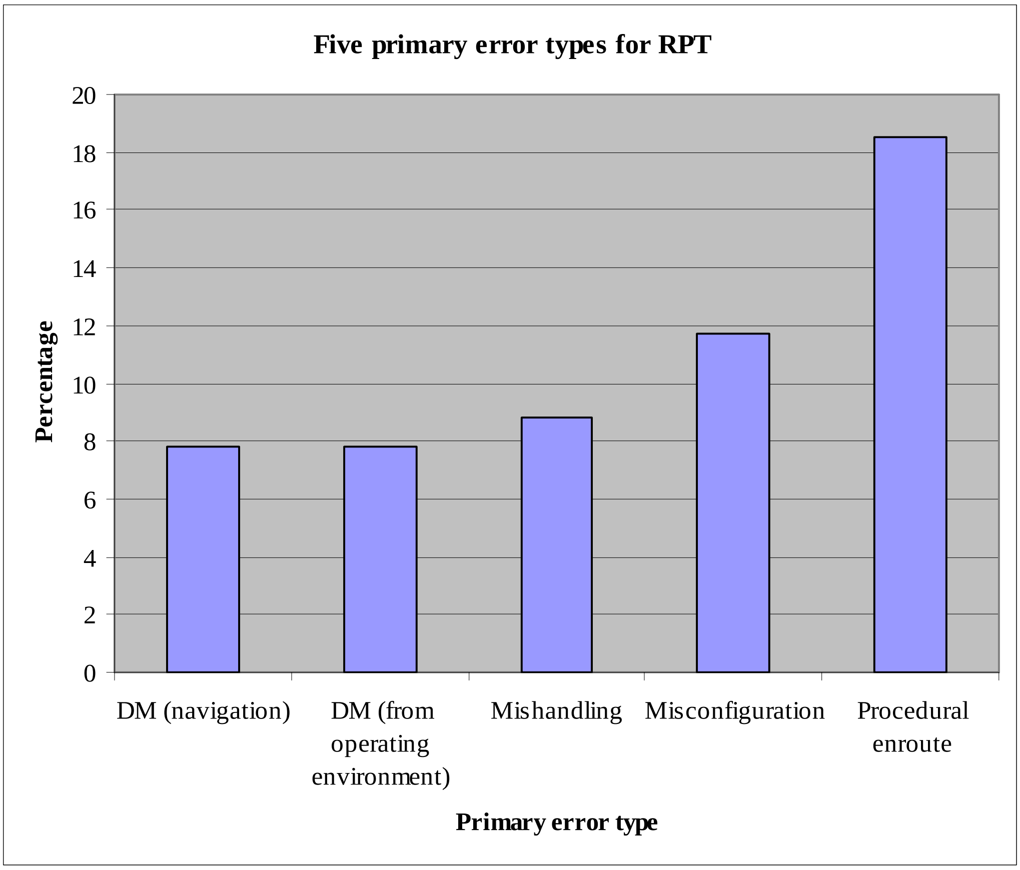
Primary error types across each flight category

This section displays the five 'primary error' types identified by pilots as contributing to their most prominent error across the four flight categories: RPT, charter, aerial work and private operations. In some cases, the sixth and seventh 'primary error' types were also identified where they were deemed important. This was based on their proximity to the other error types.

Primary error types for regular public transport

The five primary errors identified by RPT pilots are displayed in Figure 2 (N=205). The most frequently identified primary error by RPT pilots was procedural errors – en route (N=38), followed by misconfiguration (N=24), mishandling (N=18), data misprocessing – navigation (N=16), and data misprocessing – from operating environment (N=16). For data referring to all primary errors refer to Appendix D.

Figure 2: Five primary error types identified by regular public transport pilots

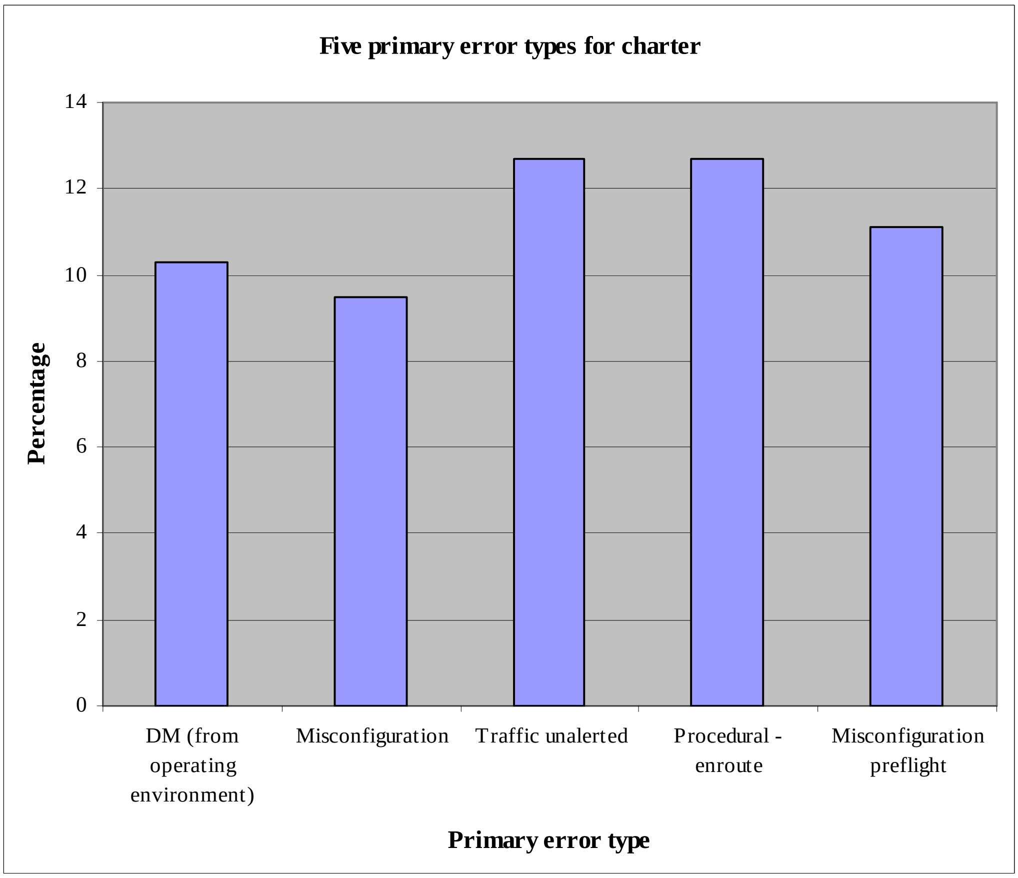


Note: DM – data misprocessing

Primary error types for charter

Figure 3 displays the five primary errors identified by charter pilots (N=126). The most frequently identified primary errors were traffic unalerted (N=16), and procedural errors – en route (N=16). These were followed by misconfiguration pre-flight (N=14), data misprocessing – from operating environment (N=13), and misconfiguration – en route (N=12).

Figure 3: Five primary error types identified by charter pilots

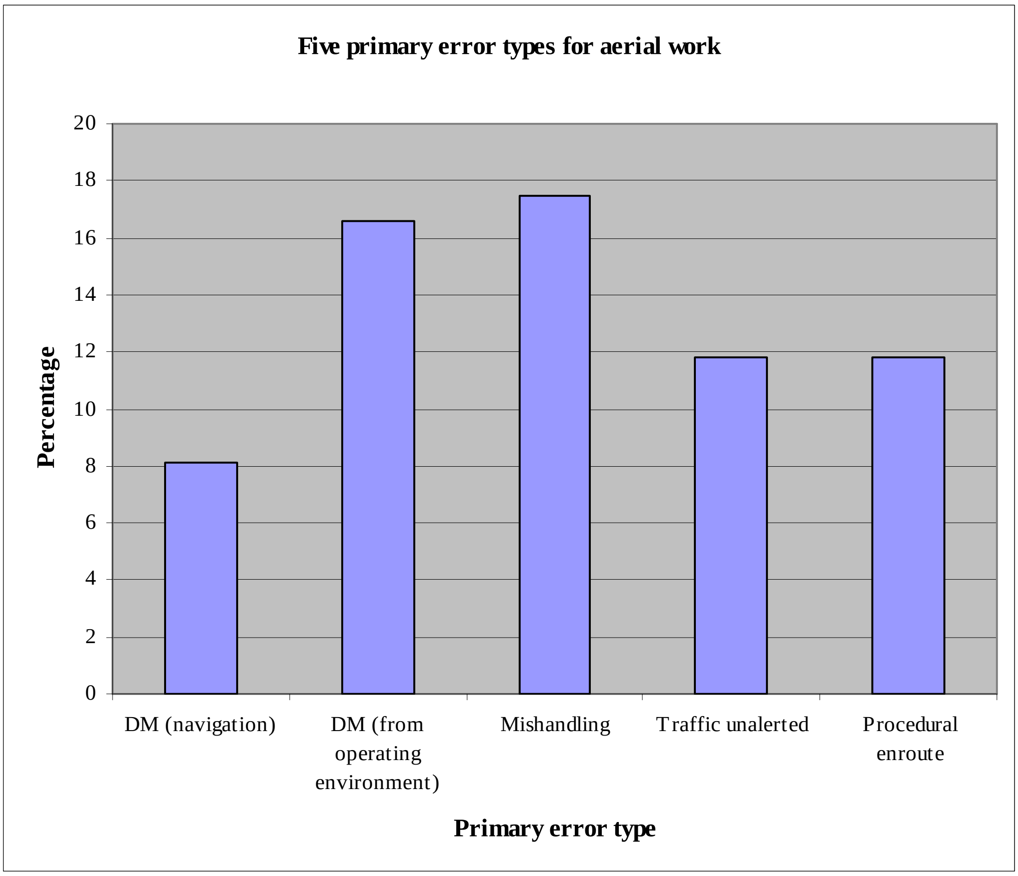


Note: DM – data misprocessing

Primary error types for aerial work

Figure 4 displays the five primary errors identified by aerial work pilots (N=211). The most frequent primary error identified was mishandling (N=37), followed by data misprocessing – from operating environment (N=35), traffic unalerted (N=25), procedural errors – en route (N=25) and data misprocessing – navigation (N=17).

Figure 4: Five primary error types identified by aerial work pilots

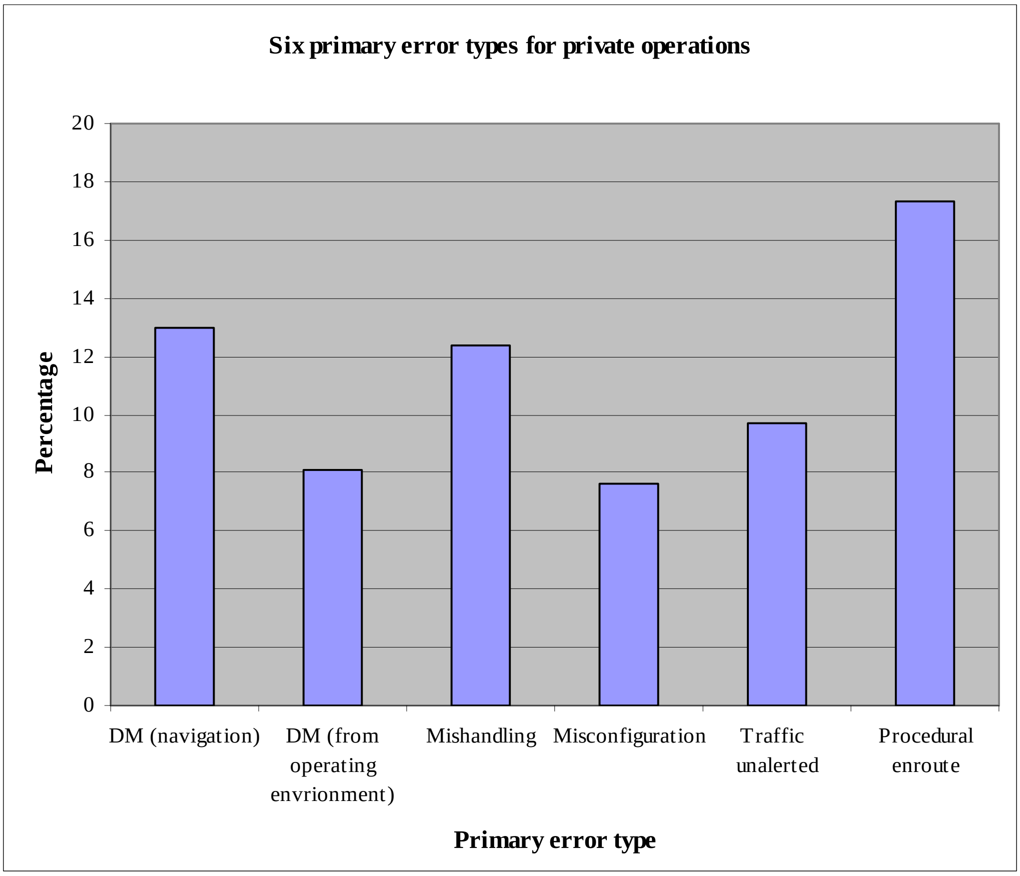


Note: DM – data misprocessing

Primary error types for private operations

Figure 5 displays six primary errors identified by private operations pilots (N=185). The most frequently identified primary errors were procedural errors – en route (N=32), followed by data misprocessing – navigation (N=24), mishandling (N=23), traffic unalerted (N=18), data misprocessing - from operating environment (N=15), and misconfiguration (N=14). The sixth primary error, misconfiguration, was included in the private operations group due to its close proximity to the fifth.

Figure 5: Six primary error types identified by private operations pilots



Note: DM – data misprocessing

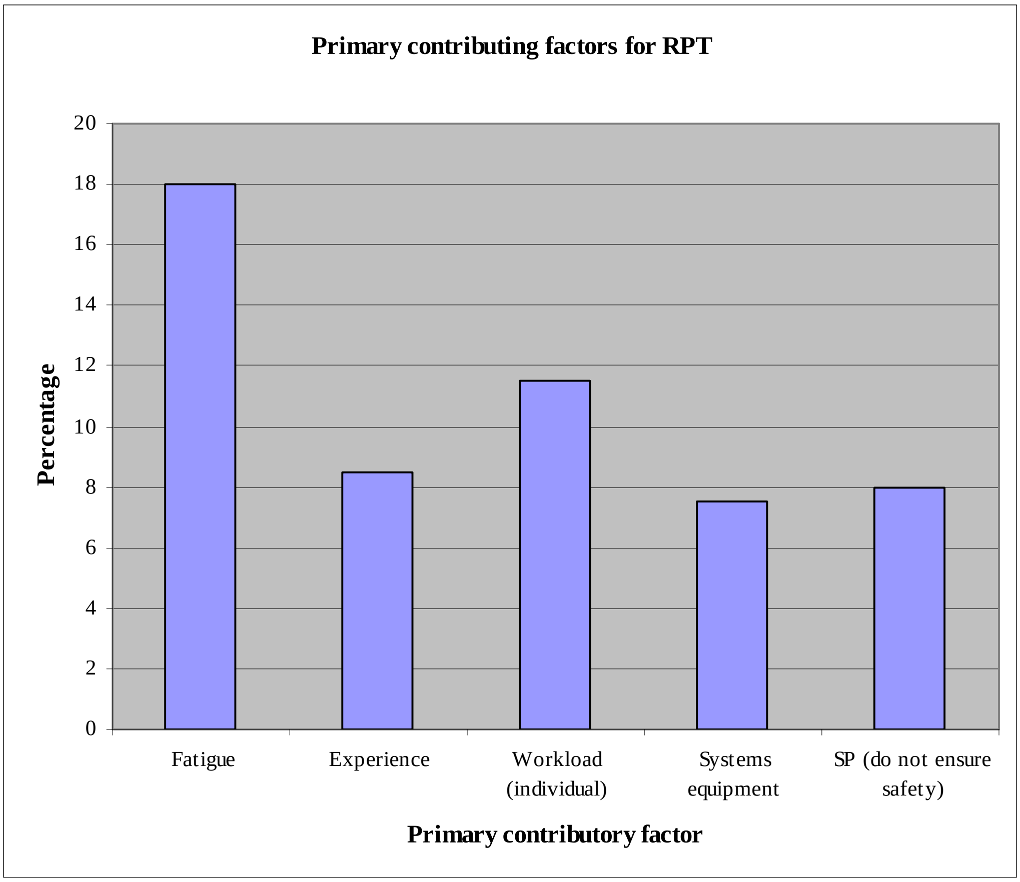
Primary and secondary contributory factors across each flight category

This section displays the five 'primary and secondary contributory factors' identified by pilots as contributing to their most prominent error across the four flight categories: RPT, charter, aerial and private. The primary contributory factors will be reported first followed by the secondary contributory factors. In some cases, the sixth and seventh 'primary and secondary contributory factors' were also identified where they were deemed important. This was based on their proximity to the other factors. The response rate for primary contributory factors was 59.3% (N=718), and for secondary contributory factors, 59.3% (N=717).

Primary contributory factors for regular public transport

Figure 6 displays the percentage of primary contributing errors identified by RPT pilots (N=200). The most frequently identified primary contributing factor was fatigue (N=36), followed by workload – individual/task level (N=23), experience (N=17), systems procedures – do not ensure safety (N=16), and systems – equipment (N=15). For data referring to all primary contributory factors refer to Appendix E.

Figure 6: Five primary contributory factors identified by regular public transport pilots

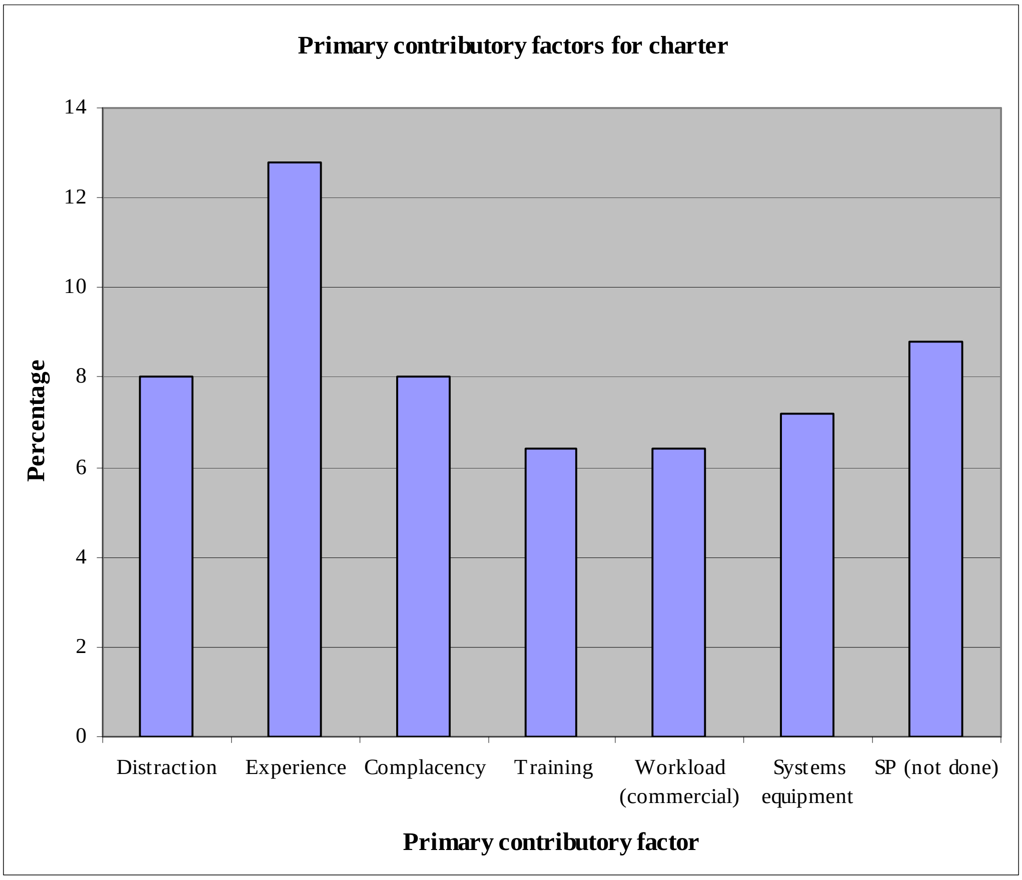


Note: SP – systems procedures

Primary contributory factors for charter

Seven primary contributing factors were identified by charter pilots (N=125). The proximity between the fifth and next factors warranted their inclusion. These were: experience (N=16), systems procedures – not done (N=11), distraction (N=10), complacency (N=10), systems – equipment (N=9), workload – commercial (N=8) and training (N=8). See Figure 7 for details.

Figure 7: Seven primary contributory factors identified by charter pilots

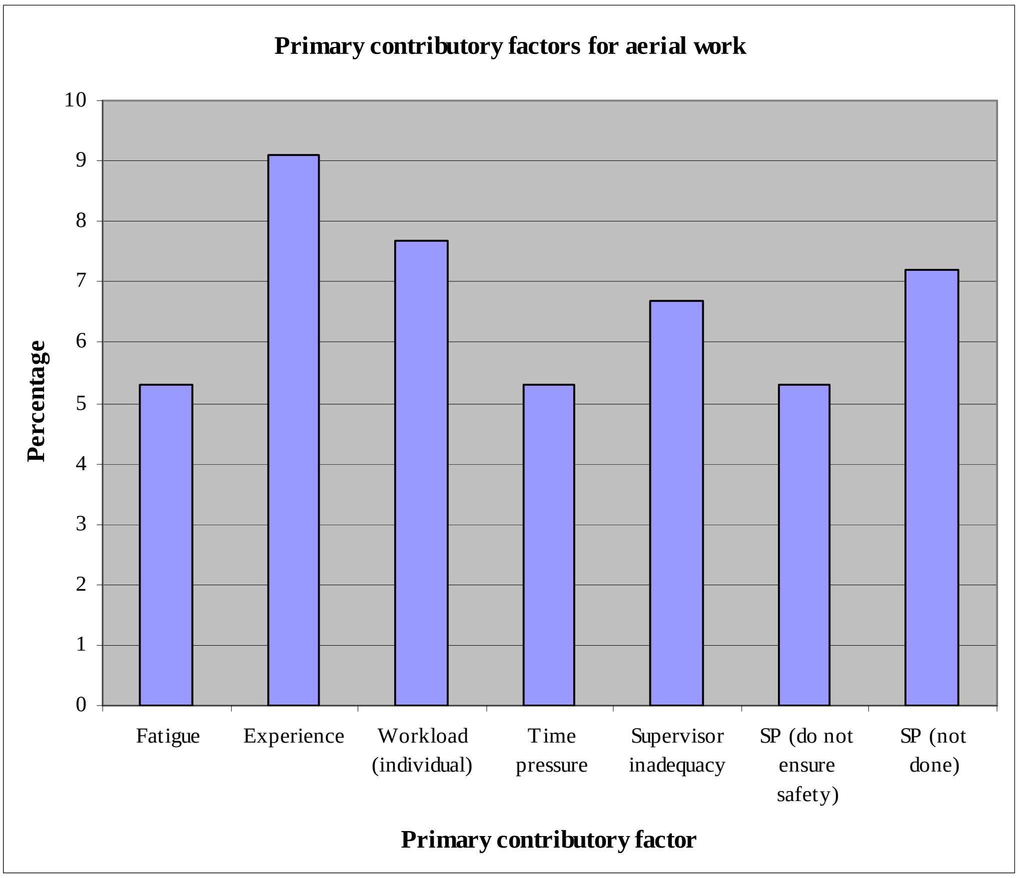


Note: SP – systems procedures

Primary contributory factors for aerial work

Seven primary contributing factors were identified by aerial work pilots (N=208). Three factors carried identical frequency ratings. The primary contributory factors were: experience (N=19), workload – individual (N=16), system procedures – not done (N=15), supervisor inadequacy (N=14), fatigue (N=11), time pressure (N=11), and systems procedures – do not ensure safety (N=11). See Figure 8 for percentage of primary contributing errors.

Figure 8: Seven primary contributory factors identified by aerial work pilots

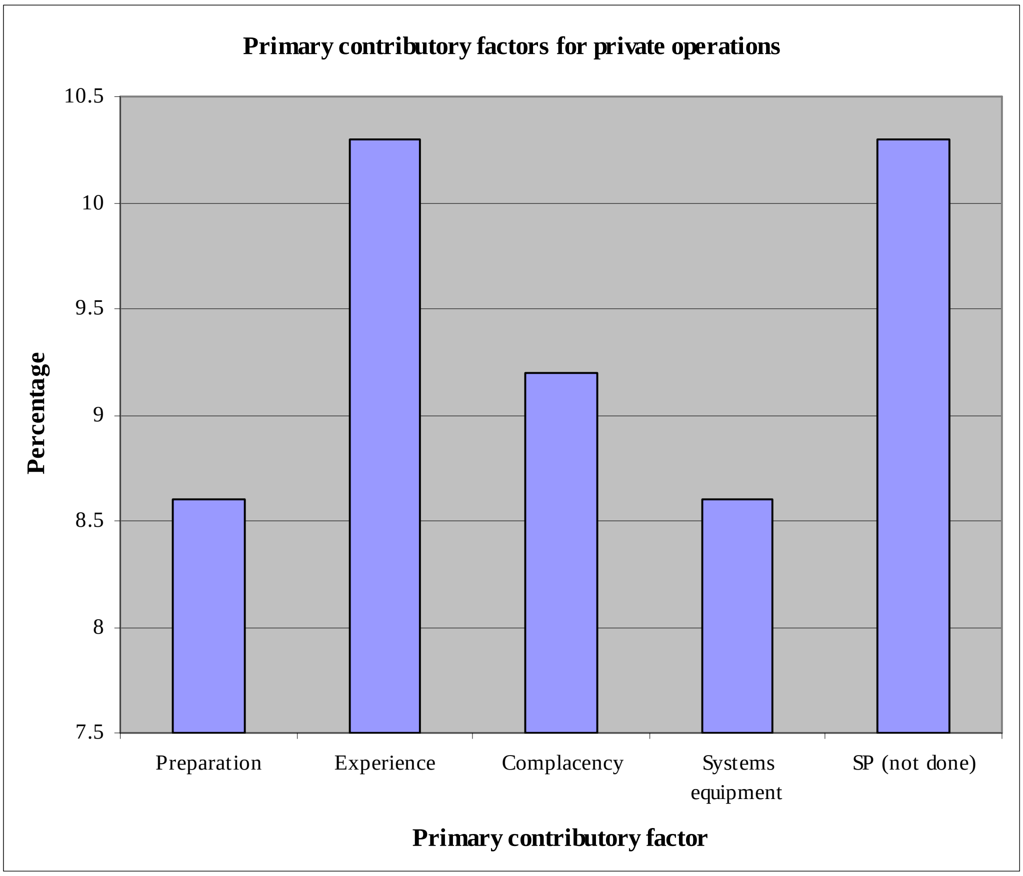


Note: SP – systems procedures

Primary contributory factors for private operations

The five primary contributing factors identified by private operations pilots are displayed in Figure 9 (N=185). The most frequently identified primary contributing factors were experience (N=19), systems procedures – not done (N=19), followed by complacency (N=17), preparation (N=16), and systems – equipment (N=16).

Figure 9: Five primary contributory factors identified by private operations pilots



Note: SP – systems procedures

Secondary contributory factors

A large proportion of pilots indicated that no secondary contributory factor was present in the incident: RPT (N=93, 46.7%), charter (N=68, 54.4%), aerial work (N=101, 48.6%), and private operations (N=107, 57.8%). Refer to Table 11 for details regarding the most frequently used secondary contributory factors, when present, by each of the flight categories. See Appendix F for details.

Table 11. Flight category and most frequently used secondary contributory factor

Secondary contributory factor		RPT	Charter	Aerial work	Private operations
Fatigue	Count	12	N/A	N/A	N/A
	%	**6.00**	**N/A**	**N/A**	**N/A**
Distraction	Count	9	5	N/A	8
	%	**4.50**	**4.00**	**N/A**	**4.30**
Preparation	Count	N/A	4	7	N/A
	%	**N/A**	**3.20**	**3.40**	**N/A**
Experience	Count	7	11	17	13
	%	**3.50**	**8.80**	**8.20**	**7.00**
Complacent/careless	Count	N/A	N/A	10	13
	%	**N/A**	**N/A**	**4.80**	**7.00**
Training	Count	8	5	9	N/A
	%	**4.00**	**4.00**	**4.30**	**N/A**
Workload - individual	Count	10	N/A	6	N/A
	%	**5.00**	**N/A**	**2.90**	**N/A**
Time pressure	Count	7	N/A	N/A	N/A
	%	**3.50**	**N/A**	**N/A**	**N/A**
Adaptation to risky situation	Count	N/A	4	N/A	N/A
	%	**N/A**	**3.20**	**N/A**	**N/A**
Systems procedures - do no ensure safety	Count	N/A	4	N/A	N/A
	%	**N/A**	**3.20**	**N/A**	**N/A**
Systems procedures – not done	Count	13	4	13	6
	%	**6.50**	**3.20**	**6.30**	**3.20**

N/A – not applicable to this flight category

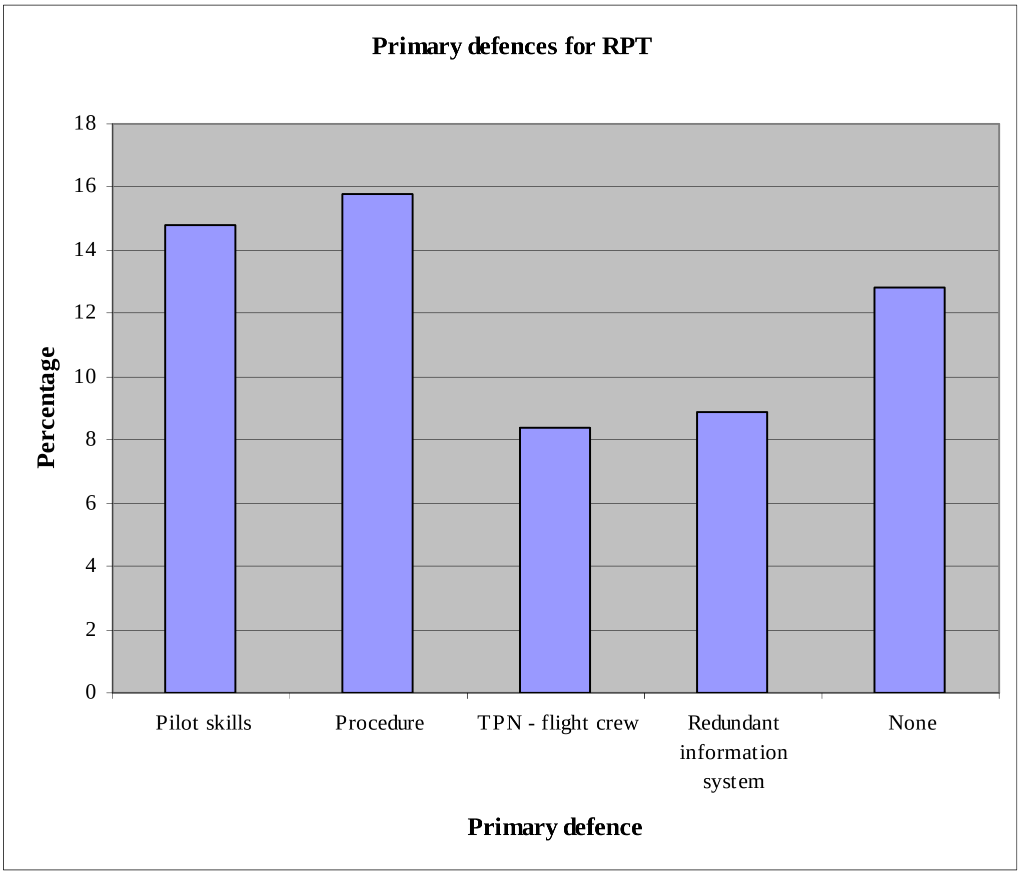
Primary, secondary and subsequent defences across each flight category

This section records the primary (N=709), secondary (N=709) and subsequent (N=714) defences pilots identified as either assisting their recovery from the error (i.e., primary and secondary), or used to reduce the likelihood of recurrence (i.e., subsequent). Caution must be taken, however, in interpreting the accuracy of the results referring to primary and secondary defences as this question may have been misinterpreted. Pilots may have interpreted question 45(c) as 'what primary defences would or could have assisted recovery from the error' rather than 'what primary defences did assist recovery from the error'. Evidence from a small number of responses indicated that this was the case, however this could not be adequately determined from the data itself.

Primary defences for regular public transport

The five primary defences identified by RPT pilots as being the most important defences during error recovery are displayed in Figure 10 (N=203). The most frequent defence was procedure (N=32), followed by pilot skills (N=30), none – no defences assisted error recovery (N=26), redundant information systems (N=18), and third party notification – flight crew (N=17). For data referring to all primary defences refer to Appendix G.

Figure 10: Primary defences utilised by RPT pilots during error recovery

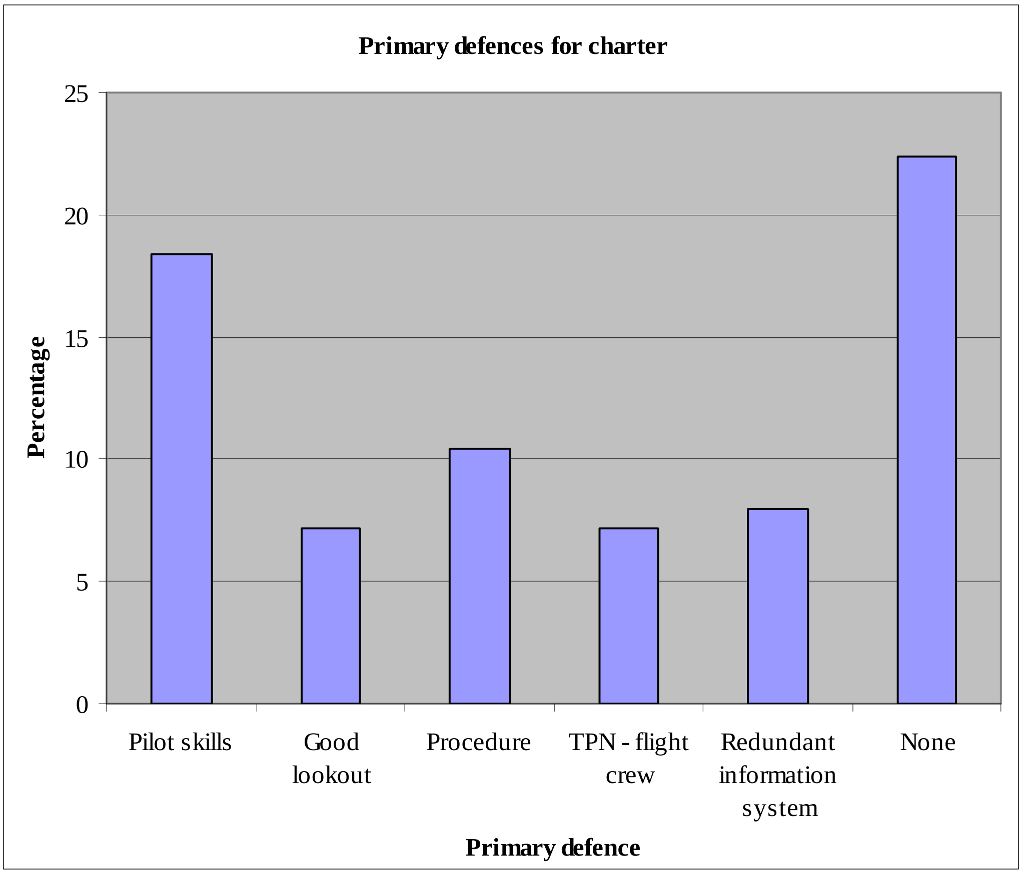


Note: TPN – third party notification

Primary defences for charter

The six primary defences identified by charter pilots as being the most important defences during error recovery are displayed in Figure 11 (N=125). Pilots indicated that in 22.4% of cases (N=28), no defences assisted error recovery. The primary defences identified by pilots were as follows: pilot skills (N=23), procedure (N=13), redundant information systems (N=10), good lookout (N=9), and third party notification – flight crew (N=9).

Figure 11: Primary defences utilised by charter pilots during error recovery

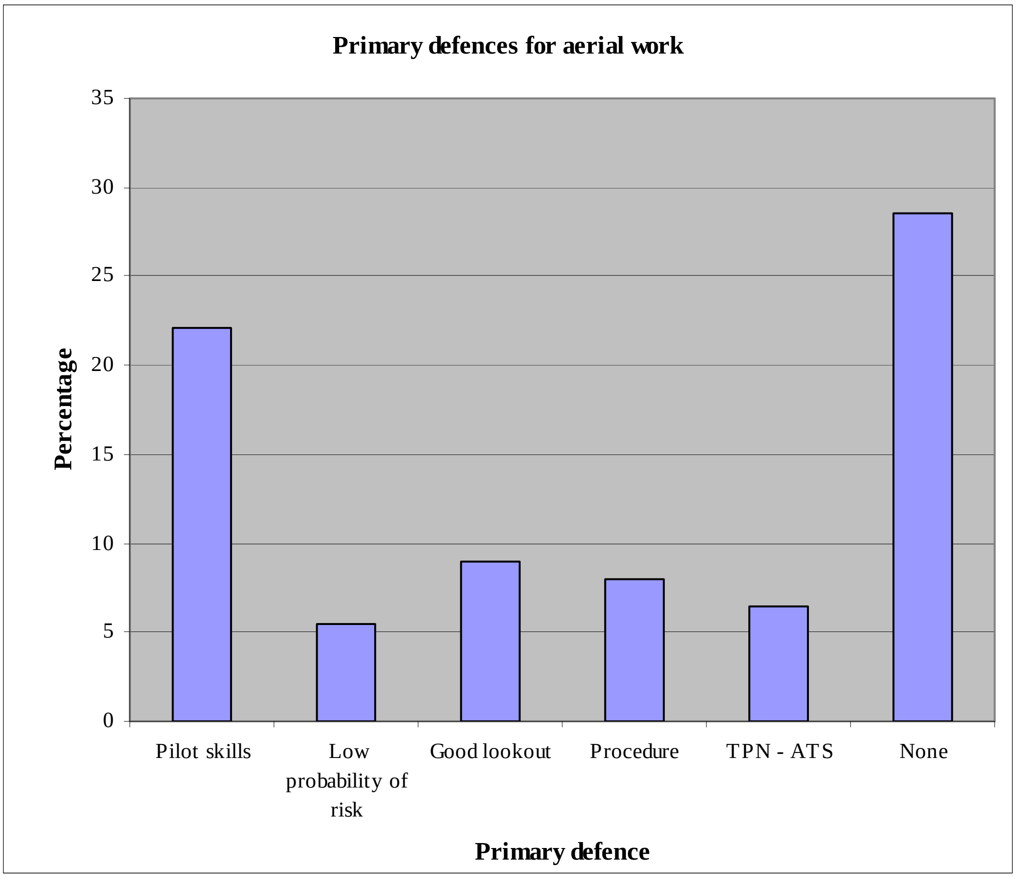


Note: TPN – third party notification

Primary defences for aerial work

The six primary defences identified by pilots engaged in aerial work are displayed in Figure 12 (N=199). Pilots indicated that in 28.6% of cases (N=57), no defences assisted error recovery. In cases where defences existed these were as follows: pilot skills (N=44), good lookout (N=18), procedure (N=16), third party notification – air traffic service(s) (N=13), and low probability of risk (N=12).

Figure 12: Primary defences utilised by aerial work pilots during error recovery

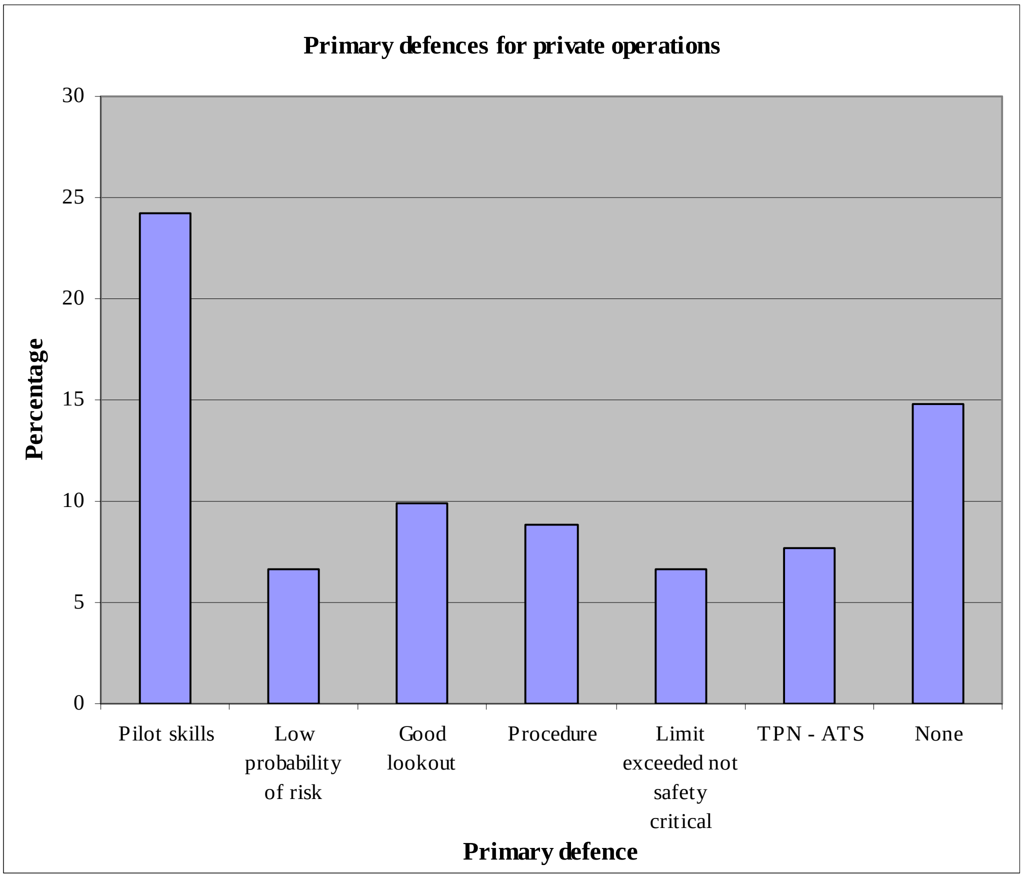


Note: TPN-ATS – third party notification - air traffic service(s)

Primary defences for private operations

The seven primary defences identified by private operations pilots (N=182) as being the most important defences during error recovery were as follows: pilot skills (N=44), none – no defences assisted error recovery (N=27), good lookout (N=18), procedure (N=16), third party notification – air traffic service(s) (N=14), low probability of risk (N=12), and limit exceeded not safety critical/ benign environment (N=12). See Figure 13 for details.

Figure 13: Primary defences utilised by private operations pilots during error recovery



Note: TPN-ATS – third party notification - air traffic service(s)

Secondary defences for each flight category

This section records the secondary defences pilots identified as providing another tool for error recovery. In this case too, caution must be used when interpreting results due to potential misinterpretation of the question. Overall, pilots indicated that no secondary defence was utilised: RPT (67.5%, N=137), charter (74.4%, N=93), aerial work (81.4%, N=162), and private operations (83.5%, N=152). Regular public transport identified pilot skills (5.4%, N=11), procedures (9.4%, N=19), and third party notification – flight crew (4.4%, N=9) as their secondary defences. Charter pilots identified pilot skills (11.2%, N=14) as their secondary defence. Aerial work pilots indicated pilot skills (3.5%, N=7), procedures (3.0%, N=6), redundant information system (3.0%, N=6), and aircraft system performance capability (3.0%, N=6), as their secondary defence. Finally, private operations pilots identified pilot skills (4.9%, N=9) and procedures (4.4%, N=8) as another tool for defence. See Appendix H for details.

Subsequent defences for each flight category

Subsequent defences refer to those strategies pilots implemented after the incident took place to reduce the likelihood of recurrence. Overall, pilots relayed that no subsequent defences had been utilised: RPT (94.1%, N=191), charter (91.3%, N=115), aerial work (91.0%, N=183), and private operations (96.2%, N=177). Regular public transport identified 12 (6.0%) post-incident strategies, charter 11 (8.8%), aerial 18 (9.0%) and private 7 (3.8%). Refer to Appendix I for details regarding what defences were implemented.

CONCLUSIONS

The goal of the current survey was to provide information to the flying community concerning those errors and violations they perceived to be the most detrimental to flight safety. The majority of respondents (87.1%) reported an incident in which they were directly involved. This increased the likelihood of obtaining detailed information concerning the types of unsafe acts that occur in the operational environment. Although third party information is invaluable to enhancing flight safety, it is often difficult to determine whether the key factors influencing the actions of the pilot directly experiencing the event were clearly identified. The fact that the data were derived from first hand experiences increases the likelihood that results reflect safety concerns in the wider operational environment, despite no in-depth causal analysis being conducted.

Results indicated that the majority of errors across all flight categories occurred en route, distantly followed by flight preparation. Responses from operational personnel concerning primary error types indicated some similarities across the flight categories. All groups experienced procedural errors – en route and misprocessed data from the operational environment. Mishandling, misconfiguration and data misprocessing – navigation were also a concern for most groups. Some similarities were also found regarding primary and secondary contributory factors. All groups identified lack of experience as important to incident involvement. Systems equipment and system procedures – not done were also identified by most flight categories. In general, operational personnel across all flight categories indicated that there were no defences present to protect against the error. When a defence was available, error recovery was predominantly enhanced by pilot skills and the implementation of procedures. Very few reports indicated that a post-event defence had been implemented to reduce the likelihood of recurrence.

REFERENCES

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Reason, J. (1997). Managing the risks of organizational accidents. Burlington, USA: Ashgate Publishing Limited.

APPENDIX A - Human Error

Investigation of safety related incidents and accidents has been a major imperative for many decades for those involved in complex technological organisations. The development of an incident or accident is a process that involves a number of different contributing factors whose type, nature and interaction can be very complex. Safety occurrences result from complex interactions between many factors including unsafe acts, factors local to the situation (e.g., weather) and latent failings residing in managerial and organisational processes (Reason, 1990).

Unsafe acts, or active failures, involve two distinct groups: errors and violations. These unsafe acts differ in the psychological mechanisms and the remedial strategies taken to combat them. Errors result from information processing problems and are best minimised by task redesign, retraining, use of memory aids, etc. Errors can be further categorised into slips/lapses involving unintended deviations of actions from what is potentially an adequate plan, and mistakes which occur when the actions go according to plan but the plan itself deviates from some necessary path to obtain the desired goal. Violations result from motivational issues which are most effectively addressed by improving morale, safety culture, attitudes, norms, etc. Distinctions can also be made between types of violations: a) routine violations, involving short cuts between task-related points taken on a regular basis; b) optimising violations, where the individual seeks to optimise some goal other than safety; and c) exceptional violations, involving one-off breaches of regulations seemingly dictated by unusual conditions (Reason, 1997).

Not all errors or violations result in an incident or accident. Unsafe acts occur in proximity to safety occurrences and play a key role in the development of an accident, however, they very rarely result in or cause accidents. This is because although they are necessary for an accident, they are not normally sufficient by themselves. Accidents are often supported by managerial or organisational systems (i.e., latent conditions) that influence the operator's performance or the ability of the system to cope with unexpected behaviours or circumstances. These latent conditions can exist within a system long before an incident/ accident occurs. It is these latent issues, combined with local conditions (e.g., weather) and errors (unsafe acts) that perchance combine with other causal factors to breach, circumvent or remove a system's (in this case aircraft's) defences.

APPENDIX B - Descriptions and examples of each error group and their elements

Error Groups

Location of Error	Description
Flight Preparation	Error occurred during preparation activities for the next flight. This error may occur due to failure to identify and correct an error completed by previous pilot
En route	Error occurred whilst executing in-flight activities
ATS	Location of error originated outside the cock-pit in ATS (Air Traffic Service(s))
Non Flight	Location of error originated outside the cock-pit during non-flight activities such as maintenance

Primary Errors

Error Group	Primary Error	Description	Examples (quoted from reports)
Flight Preparation	Data gathering (wrong)	During preparation for flight: Information that is obtained is inaccurate – crew either get the wrong information or the information is incorrect	• Attempted ag operations out of agricultural air strip not previously used or inspected by our company (took airstrip owners advice that airstrip was serviceable) • Took another pilots (owner's) word for the fact that fuel drains had been done (they had not)
	Data gathering (not gathered)	During preparation for flight: Important information is not acquired by flight crew	• Private pilots flying with overloaded aircraft – not determining correct weights • Aircraft running out of fuel - aircraft usually filled night before to full tanks, not done in this case, pilot didn't check
	Data misinterpretation (i.e., processing/derivation)	During preparation for flight: Correct information is gathered, but errors arose during processing of the information	• Incorrect weight used for take off calculation; flight planning error • The aircraft flight plan was slightly different to the one submitted. This resulted in the aircraft being in a different location to what was expected by ATC
	Data entry - wrong	During preparation for flight: Correct information is gathered and/ or interpreted however is entered into aircraft systems incorrectly	• Missing height requirement on STAR • Entered incorrect information into GPS
	Misconfiguration – pre-flight	During preparation for flight: Aircraft equipment or systems have not been configured correctly prior to take off	• Incorrect configuring of fuel system during pre-flight deck preparation • Oil caps in aircraft not fastened properly
	Procedural – Flight preparation	During preparation for flight: Procedures pertaining to pre-flight requirements were not executed	• Loading passengers by ground staff was contrary to procedures. Where appropriate procedures rules were ignored due to pressure to meet scheduled departure time • Failed to complete pre-flight checks
En route	Data misprocessing (fuel)	Miscalculation during flight regarding fuel quantity and amount necessary to reach destination	• Incorrect estimation of fuel required after change in scheduled destination • Incorrect estimation of fuel remaining
	Data misprocessing (navigation)	Misprocessing of navigational information that is provided for managing a flight	• Incorrect identifier GPS • Took off on wrong runway

	Data misprocessing (information changes)	Operational information available during the flight that is relevant to flight management not received or acted on appropriately	• Information concerning change of destination not provided • Misinterpreted information concerning flight change – direction of circuit
	Data misprocessing (from operating environment)	Misinterpreted potential sources of information from the environment.	• Downwind landing with near overrun of runway • Landing in poor visibility due rain shower over the threshold (rain unexpectedly heavy)
	Communications – radio	information not transmitted effectively by radio	• Failure to monitor • Failed response due to congestion
	Mishandling	Control inputs inappropriate to ensure safe flight	• Unstable approach • Aircraft landed heavily on the nose wheel collapsing the nose strut – prop contacted runway
	Misconfiguration	Aircraft equipment not set correctly to achieve desired task.	• Landed with a flap setting one less than configured for • The pilot selected the heading bug instead of the CAB without realising, whilst on visual approach. This caused the aircraft to turn inside the run
	Traffic – unalerted	Two aircraft closer than expected, and neither had prior knowledge of the proximity of the other	• An aircraft taxied onto my runway during the take off run/rotate sequence. Other aircraft missed by less than a wingspan • Near miss – at an inbound reporting point attached to a GAAP aerodrome
	Traffic – alerted	Two aircraft closer than expected, and had prior knowledge of the proximity of the other	• King Air climbed through our level while IMC. Both aircraft were IFR and ATC passed us as traffic. We estimate the King air missed us by about 2 nm • Came close to opposite direction traffic. It was departing and MBZ, I was arriving on a reciprocal track
	Procedural – En route	Procedures are not complied with	• Aircraft landed behind us while we were still on the runway and turning to backtrack to taxiway • Pilot in controlled airspace cut in front of another on final – despite being allotted landing
	Time pressure risk enhancement	Compression of normal procedures in an attempt to take less time	• Rushed approach, aircraft only becoming stable at 500ft • Rushing procedures to ensure on-time performance
	Other – En route	Categorises those errors occurring en route that do not fall into the remaining categories	• Lightning strike taking out flight instruments, radio, NAV aids, etc • Poor judgement in performing aerobatics – too low and close to spectators (loss of aircraft)
Air Traffic Services	Misidentification	Misidentifying one aircraft for another	• Two low wing singles on the final. Tower misidentify aircraft sequence and cleared aircraft number two on final to land before clearing aircraft number-one on short final for same runway
	Traffic confliction	Two or more aircraft unintentionally placed on conflicting path	• ATC cleared us to land and subsequently cleared an aircraft to depart on conflicting runway • Traffic separations in MBZ or CTAFs/ typically two regional RPT aircraft, one on descent and one on climb

	Routine practice	Procedures that are standard practice, but are not inherently resilient	• My aircraft instructed to line up at an intersection (ahead of a 747), commuter aircraft lined up at an intersection ahead of my aircraft. Three aircraft on the same runway. Runway approximately 500 metres. Commuter aircraft cleared to take off, 747 acknowledged please take off – Runway occupied by more than one departing aircraft
Non Flight	Maintenance	Error affecting the aircraft occurred during maintenance	• During maintenance pitch and roll disconnect handles were positioned in the opposite, so the pitch disconnects were in the roll disconnect position and vice versa • Component incorrectly fitted to an aircraft
	Unqualified	Individual(s) involved did not hold the necessary qualifications resulting in potentially unsafe situation	• Individual carried out maintenance work to help others with high workload – Unqualified – engine failure in flight
	Other – Non flight	Non-flight events that do not fall into the other categories	• Observed a few pilots flying with out of date charts and documents

Primary and Secondary Contributory Factors

Factor	Description	Examples
Fatigue	Fatigue reduces operator performance	• Fatigue (10 hour night sector), lack of recency and lack of recovery in the environment • Fatigue – both pilots – caused by high workload in IMC with unusual or infrequently performed approach procedures in use at destinations
Distraction	Operator's attention diverted from safety-critical task	• Single pilot charter – engaged in conversation with passengers (distracted from task) • Distracted whilst mustering cattle
Preparation	Errors hidden in flight planning	• Using an existing flight plan that contained an error. Not checking that pilots and ATS copy were the same (this was the result of the flight planning software) • Mid point of flight plan – temperature rose above forecast (second landing for the day) climb performance was reduced
Recency	Lack of recent practice of a particular skill-set	• Visual approach in RPT heavy seldom practised • Recently endorsed on type, first 2 crew experience, short sector, with a steeper descent profile than the normal type
Experience	Lack of knowledge that is not normally acquired through formal training processes, but gained from practical experience	• Previous owner had mixed fuels that resulted in flakes being formed in fuel components including the carburettor main jet. He was unaware that lead replacement MOGAS and AVGAS do not mix. Whereas the old super MOGAS would have • Higher speed than aircraft can manage comfortably under wet conditions
Complacent/careless	Lack of concern regarding risk of unsafe outcome	• Gliders landing downwind against circuit direction on parallel runway to powered flight aircraft – laziness – less distance to return gliders to hangar • Pilots willingness to take undue risks during low-level flying – Attitude of invulnerability

Training	Training inadequate to provide knowledge, skills and experience to ensure safe operations	• Near overrun of runway – short strip, very light winds and very inexperienced pilots • Pilots with lack of proper training before commencing line flying operations
Get-home itis	Desire to complete operation influences operational decision making	• Pressing on • Took off (IFR) into potential icing situation – pressing on – wanted to get home
Workload – individual	The number of tasks an individual needs to attend to at a given time – may involve multiple tasks and/ or complex tasks	• Potential near midair collision – poor R/T, difficulty in understanding foreign accents, high workload airspace , weather • Late drop on fire into rising terrain - smoke restricting vision, position of fire, misjudged extent of climb angle required
Misinformation	Information transfer process does not ensure complete, correct transfer of information	• Incorrect information • Overloaded aircraft – Unreliable fuel burn figures in aircraft data sheets
Unqualified for task	Does not hold qualifications required for the conduct of the task	• Helicopter mishandled (door opened in flight, lost control) – pilot had not flown for five years • Unqualified IFR flight
Time pressure	Perceived time constraints influence operational decision making	• Med 1 flight • Over-torque during overshoot from low-level water-bombing run- strong wind and turbulence, desire to hold load to make effective drop on burning house
Non-task related stress	Inappropriate stressors from work environment	• Stress • Job security
Workload – Commercial pressure	Inappropriate pressure applied to flight crew operational decision making by operating company	• Duty time exceeded, all-day op, deteriorating weather – strong desire by manager and crew to have helicopter return to base • flying below LSALT, VMC in mist, low cloud – commercial pressures → schedule, job insecurity
Money/ financial considerations	Financial pressures influence operational decision making, procedures or work practices	• Personal high costs to maintain proficiency in twins while main commitment to SE operations. Company contribution reasonable but in the current economic climate as much as could be reasonably expected • Loading procedures breached – management pressure on ground staff – contract employees are penalised for not meeting minimum ground aircraft turnaround time (which is inadequate)
Adaptation to risky situation	Habituation to risky procedure	• Runway occupied by more than one departing aircraft • Unqualified IFR flight (high NVFR experience) – pilot has done it on occasions for many years
Supervisor inadequacy	Supervisory role-holder incapable of ensuring safety of operation	• Failure to take control of the aircraft when a student pilot had reached their limit. The situation developed past what the instructor could then safely and effectively maintain control • A student left the master switch on in a high-powered single engine aircraft. The battery was strained. As instructor I did not adequately supervise the students shut down checks
Systems – unsafe eg unalerted See and Avoid	Current systems do not ensure safety	• Near miss – No notification of aircraft in the area • Near miss in MBZ – lost visual identification and near misses occurred
Systems – Equipment	Use of aircraft equipment did not achieve the designed outcome from the use of that equipment, or does not support easily achieving the designed outcome	• Frequency congestion; insufficient aircraft to aircraft communication – VHF congestion • Poor rain shedding of cockpit windows • Printing on Jepp chart too much and too small

Systems procedures – do not ensure safety	System not robust (designed to reduce the probability of error) or resilient (designed to ensure timely identification of error, or out of tolerance situation)	• Configuring pre-flight is a memory item • See and avoid – impossible where other aircraft is not sure of position relative to airfield. All MBZs should be the same size either 15nm or 30nm not both
Systems procedures – not complied with (unwitting)	Lack of knowledge of procedures, or forgot procedures	• Overloaded flights – lack of knowledge on weights with of fuel on different aircraft • Pilot fuel planning – pilots didn't lean aircraft properly (don't know correct procedure)
Systems procedures – interrupted /disconnected /fail	System or procedure vulnerable to interruptions or changes	• Change in crew (late notice) leading to breakdown of checklist • None exist
Wilful violation	Conscious non-compliance with a safety-critical requirement	• The pilot in the following aircraft did not allow enough room between us, even after we had told him we would need to backtrack. He did not seem worried that we would still be on the runway • An aircraft flying too close to me in formation then moving across the flight path causing some discomfort to passengers due to associated turbulence – Poor judgement on the part of the other pilots. Getting too close to take a photo of my aircraft in flight
Managerial – change implementation	Changes not managed to ensure that safety is not compromised by the change	• Poor management implementation of take off speed setting changes • Airspace violation – congested radiofrequency, new procedure had a different interpretation between controllers and pilots
Concentration	Lack of attention to appropriate information during phases of a flight	• Less than adequate monitoring of aircraft systems • Joining the wrong position in the circuit area and the wrong runway – Not thinking ahead of the aircraft and not enough thought about the runway in use and where I was supposed to join
Other	Events that do not fall into other categories	• Controlled airspace traffic confliction – ATC separation breakdown • No specific contributory factor given
Systems procedures – not done	Safety procedures not done	• Failure to have figures cross checked • Approaching airfield lowish cloud 6/8 at about 1200ft – three aircraft in circuit – aircraft from north did not communicate on correct frequency

Primary and Secondary Defences

Factor	**Description**	**Examples**
Optimising violation	Non-compliance with a requirement with the intent of performing the task better	• Pilot joining circuit right downwind left-hand circuit – blatant attempt to try to avoid slowing down in circuit due to traffic ahead • VFR through cloud and too close to cloud – Pushing VFR in climb through cloud to VFR conditions on top and at destination
Recency	Recent practice of the required skill-set	• Aircraft running off the runway in strong winds – training in crosswind landings • Lack of recency on aircraft
Pilot skills	Pilot's ability to perform task	• Good training for flight planning and multi crew briefing provided plan of escape route • Good CRM • Local knowledge to find alternate landing; intimate knowledge of aircraft type
Culture towards safety related issues	Prioritisation of safety-critical tasks in whole work sequence	• Discipline; willingness to accept the consequences of late departures • Intervention by captain to ensure all safety procedures were adhered to

Low probability of risk manifestation	Low probability of risky event leading to unsafe outcome	• Three aircraft – one not on correct frequency – separation was sufficient due to luck • Checklist oversights – Non-critical items or items already configured
Good lookout	Enhanced awareness of operating environment	• Protection against unalerted traffic – sighting, vigilance, regarding other aircraft • Traffic conflictions – familiarisation with airport and operation, visually sighting traffic
Procedure	Operating procedures designed to enhance robustness or resilience	• High workload switch errors – recovered using appropriate checklist and backup safety systems like EGPWS • taxiing out for departure without required fuel on board - checklist that covers critical items twice – the oversight was realised prior to departure
Limit exceeded not safety critical/ benign environ	Environment meant that safety exceedence did not lead to an unsafe outcome	• Near overrun of runway – a little bit of luck and a softer strip due to recent rainfall (gravel runway) • Landed downwind on PFL in relatively strong wind – Runway was long enough to accommodate the mistake
Third party notification - flight crew	Notification of safety-critical exceedence by other member of flight crew	• Crew environment that encourages questioning irregularities • Situational awareness of crew, querying ATC instructions (avoided potential collision)
Third party notification - ATS	Notification of safety-critical exceedence by ATS	• ATC on the ball and picking up quickly on the situation; guidance from Air Traffic Control • ATC checking my reporting point (aircraft flight plan different to one submitted. Aircraft in different position expected by ATC)
Third party notification - Aircraft system stick shaker	Notification of safety-critical exceedence by aircraft sensing and warning systems	• Correct operation of aircraft safety device - stick shaker • ILS approach requiring the use of speed break beyond the flap setting for use of speed break, resulting in stick Shaker activation at 3000 ft.AGL – complacency due to route familiarity, first flight after leave, not properly prepared for the flight after holidays, poor performing co-pilot (failed to monitor my approach closely enough)
Third party notification - Aircraft system TCAS	Notification of other aircraft proximity by TCAS system	• TCAS showed less than 1,000 ft. separation in the cruise with opposite direction traffic • aircraft equipped with TCAS and Mark 1 eyeball • TCAS and visual observation
Third party notification - Other	Notification of safety-critical exceedence by system or person not falling into other categories	• We advised ATC of the impending conflict (between two other aircraft) and it was promptly resolved • Apparently went above 6,000 ft. into RAAF airspace for a brief time – Not aware of violation until later advised (two months later)
Redundant information system	Information provision, retrieval and processing conducted by parallel independent channels and compared for consistency	• Aircraft warning; ATC superb • multi-crew environ – crew noticed something not right
Aircraft system performance capability	Aircraft capable of performing beyond defined limits	• Mistake in recognising crosswind – A strong aeroplane • Landed with a flap setting one less than configured for – aircraft still has adequate margin over stall in that configuration
Conservative practice	Designing procedures with conservative safety margins	• Knowledge that performance deteriorates at certain times and take precautions • I took the owners advice on fuel consumption over what the pilot's operating handbook stated – Personally imposed fuel reserve on top of the required
None	No defence was present or example not considered to be a defence	• Collision with fuel tank – insurance company and engineer • Loss of control during low steep turn onto final approach – aircraft crashed

Third party assistance	Provision of assistance by third party in safety-critical event	• Aircraft caught on fire on start up – immediate help available • On giving a taxi call for our RPT departure, pilot called to say he was inbound to airport but unsure of his position and ask for help to find it – We pointed out two major land features and waited until he landed safely
Third party notification - aircraft system other	Notification of safety critical exceedence by aircraft sensing and warning system that does not fall into another category.	• Failure to lower landing gear on approach – Landing gear up ground proximity warning • Descending through assigned altitude 3- 400 ft. in CTA – Altitude alerting system

Subsequent Defences

Factor	**Description**	**Examples**
Developed procedure	Existing procedure enhanced likelihood of a safe outcome	• Oil level too low – discovered by next pilot to fly (high oil usage not promulgated by company) – change to company documentation and procedures
Supervisor intervention	Provision of assistance by supervisor in safety-critical event	• Company pilot knowingly took off overweight – remedial training conducted, pilot counselled, an attempt at passenger education as to baggage on small aircraft. All actions post flight • Pilot handling aircraft (Rotary) in unprofessional manner (too close to other aircraft) – reminded pilot of the machine that he was flying
Further training	Provision of further training to enhance knowledge, skills and experience	• Further training (at Company cost) more ground briefing to support remedial flying • Pilot fuel planning errors (pilots didn't lean aircraft properly) – retraining
Learned from experience	Experience from current event enhanced ability to achieve a future safe outcome	• Collision with obstacle – Constant revising of operation • Exiting wet runway at high speed taxiway – Awareness of requirement for slower speed under these conditions/braking was effective
Support development of safety culture	Organisation makes effort to enhance safety culture	• Incorrect fitment or adjustment of a part leading to engine power failure on final approach – Consultation with maintenance staff, resetting priorities and refocusing them on safety goals. Better management of rest periods • Minor switching errors (fatigue) – more time off to be rested
Additional equipment fitted	System installed to enhance knowledge regarding a safety-critical aspect of a flight	• Attempting to start the takeoff roll without doing all pre-take off checks which would have resulted in bleed air being left off - second pilot noticed error. Company has since fitted audio alarms to fleet • Failure to see traffic – aircraft on final saw and avoided ag aircraft doing simulated spray run – radios now fitted to all aircraft based at airfield as a requirement
No subsequent defence given		

APPENDIX C - All data for flight category and location of error

		Flight Category				
Error Group		RPT	Charter	Aerial	Private	Total
Flight preparation	Count	46	28	29	29	132
	%	**22.4**	**22.2**	**13.7**	**15.7**	**18.2**
En route	Count	147	88	169	150	554
	%	**71.7**	**69.8**	**80.1**	**81.1**	**76.2**
ATS	Count	8	1	3	0	12
	%	**3.9**	**0.8**	**1.4**	**0.0**	**1.7**
Non-flight	Count	4	9	10	6	29
	%	**2.0**	**7.1**	**4.7**	**3.2**	**4.0**
Total	Count	205	126	211	185	727
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

APPENDIX D - Primary error types across the four flight categories

Primary Error		Flight Category				Total
		RPT	Charter	Aerial	Private	
Data gathering (wrong)	Count	2	0	2	3	7
	%	**1.0**	**0.0**	**0.9**	**1.6**	**1.0**
Data gathering (not gathered)	Count	5	6	3	10	24
	%	**2.4**	**4.8**	**1.4**	**5.4**	**3.3**
Data misinterpretation (i.e., processing /derivation)	Count	7	4	5	8	24
	%	**3.4**	**3.2**	**2.4**	**4.3**	**3.3**
Data misprocessing (fuel)	Count	1	2	1	1	5
	%	**0.5**	**1.6**	**0.5**	**0.5**	**0.7**
Data misprocessing (navigation)	Count	16	9	17	24	66
	%	**7.8**	**7.1**	**8.1**	**13.0**	**9.1**
Data misprocessing (information changes)	Count	1	1	2	4	8
	%	**0.5**	**0.8**	**0.9**	**2.2**	**1.1**
Data misprocessing (from operating environment)	Count	16	13	35	15	79
	%	**7.8**	**10.3**	**16.6**	**8.1**	**10.9**
Communications - radio	Count	7	6	7	10	30
	%	**3.4**	**4.8**	**3.3**	**5.4**	**4.1**
Mishandling	Count	18	10	37	23	88
	%	**8.8**	**7.9**	**17.5**	**12.4**	**12.1**
Misconfiguration	Count	24	12	9	14	59
	%	**11.7**	**9.5**	**4.3**	**7.6**	**8.1**
Traffic - unalerted	Count	10	16	25	18	69
	%	**4.9**	**12.7**	**11.8**	**9.7**	**9.5**
Traffic - alerted	Count	4	1	2	2	9
	%	**2.0**	**0.8**	**0.9**	**1.1**	**1.2**
Procedural - en route	Count	38	16	25	32	111
	%	**18.5**	**12.7**	**11.8**	**17.3**	**15.3**
Time pressure risk enhancement	Count	9	1	5	2	17
	%	**4.4**	**0.8**	**2.4**	**1.1**	**2.3**
Misidentification	Count	1	0	1	0	2
	%	**0.5**	**0.0**	**0.5**	**0.0**	**0.3**
Maintenance	Count	4	8	8	5	25
	%	**2.0**	**6.3**	**3.8**	**2.7**	**3.4**
Traffic confliction	Count	6	1	2	0	9
	%	**2.9**	**0.8**	**0.9**	**0.0**	**1.2**
Data entry - wrong	Count	11	1	1	0	13
	%	**5.4**	**0.8**	**0.5**	**0.0**	**1.8**
Routine practice	Count	1	0	0	0	1
	%	**0.5**	**0.0**	**0.0**	**0.0**	**0.1**
Misconfiguration – pre-flight	Count	12	14	9	4	39
	%	**5.9**	**11.1**	**4.3**	**2.2**	**5.4**
Unqualified	Count	0	1	2	0	3
	%	**0.0**	**0.8**	**0.9**	**0.0**	**0.4**
Other - en route	Count	3	1	4	5	13
	%	**1.5**	**0.8**	**1.9**	**2.7**	**1.8**
Procedural - flight preparation	Count	9	3	9	4	25
	%	**4.4**	**2.4**	**4.3**	**2.2**	**3.4**
Other – non-flight	Count	0	0	0	1	1
	%	**0.0**	**0.0**	**0.0**	**0.5**	**0.1**
Total	Count	205	126	211	185	727
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

APPENDIX E - Primary contributing factor across the four flight categories

Primary Contributory Factor		Flight Category				Total
		RPT	Charter	Aerial	Private	
Fatigue	Count	36	7	11	5	59
	%	**18.0**	**5.6**	**5.3**	**2.7**	**8.2**
Distraction	Count	6	10	9	12	37
	%	**3.0**	**8.0**	**4.3**	**6.5**	**5.2**
Preparation	Count	4	2	10	16	32
	%	**2.0**	**1.6**	**4.8**	**8.6**	**4.5**
Recency	Count	6	0	6	14	26
	%	**3.0**	**0.0**	**2.9**	**7.6**	**3.6**
Experience	Count	17	16	19	19	71
	%	**8.5**	**12.8**	**9.1**	**10.3**	**9.9**
Complacent/careless	Count	10	10	10	17	47
	%	**5.0**	**8.0**	**4.8**	**9.2**	**6.5**
Training	Count	5	8	9	6	28
	%	**2.5**	**6.4**	**4.3**	**3.2**	**3.9**
Get home itis	Count	2	2	2	5	11
	%	**1.0**	**1.6**	**1.0**	**2.7**	**1.5**
Workload – individual/task level	Count	23	4	16	4	47
	%	**11.5**	**3.2**	**7.7**	**2.2**	**6.5**
Misinformation	Count	6	3	8	3	20
	%	**3.0**	**2.4**	**3.8**	**1.6**	**2.8**
Unqualified for task	Count	1	1	2	0	4
	%	**0.5**	**0.8**	**1.0**	**0.0**	**0.6**
Time pressure	Count	7	6	11	4	28
	%	**3.5**	**4.8**	**5.3**	**2.2**	**3.9**
Non-task related stress	Count	0	4	2	1	7
	%	**0.0**	**3.2**	**1.0**	**0.5**	**1.0**
Workload – commercial pressure	Count	12	8	9	2	31
	%	**6.0**	**6.4**	**4.3**	**1.1**	**4.3**
Money/ financial considerations	Count	2	1	3	5	11
	%	**1.0**	**0.8**	**1.4**	**2.7**	**1.5**
Adaptation to risky situation	Count	1	0	3	1	5
	%	**0.5**	**0.0**	**1.4**	**0.5**	**0.7**
Supervisor inadequacy	Count	1	4	14	3	22
	%	**0.5**	**3.2**	**6.7**	**1.6**	**3.1**
Systems – unsafe eg unalerted See and Avoid	Count	1	3	6	3	13
	%	**0.5**	**2.4**	**2.9**	**1.6**	**1.8**
Systems – equipment	Count	15	9	8	16	48
	%	**7.5**	**7.2**	**3.8**	**8.6**	**6.7**
Systems procedures – do not ensure safety	Count	16	7	11	10	44
	%	**8.0**	**5.6**	**5.3**	**5.4**	**6.1**
Systems procedures – not complied with (unwitting)	Count	3	2	9	9	23
	%	**1.5**	**1.6**	**4.3**	**4.9**	**3.2**
Systems procedures – interrupt/disconnect/fail	Count	2	5	2	1	10
	%	**1.0**	**4.0**	**1.0**	**0.5**	**1.4**
Wilful violation	Count	1	0	5	5	11
	%	**0.5**	**0.0**	**2.4**	**2.7**	**1.5**
Managerial – change implementation	Count	1	0	0	0	1
	%	**0.5**	**0.0**	**0.0**	**0.0**	**0.1**
Concentration	Count	0	0	1	2	3
	%	**0.0**	**0.0**	**0.5**	**1.1**	**0.4**
Other	Count	9	2	7	3	21
	%	**4.5**	**1.6**	**3.4**	**1.6**	**2.9**
Systems procedures – No done	Count	13	11	15	19	58
	%	**6.5**	**8.8**	**7.2**	**10.3**	**8.1**
Total	Count	200	125	208	185	718
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

APPENDIX F - Secondary contributing factor across the four flight categories

Secondary Contributory Factor		Flight Category				Total
		RPT	Charter	Aerial	Private	
Fatigue	Count	12	1	4	2	19
	%	**6.0**	**0.8**	**1.9**	**1.1**	**2.6**
Distraction	Count	9	5	5	8	27
	%	**4.5**	**4.0**	**2.4**	**4.3**	**3.8**
Preparation	Count	2	4	7	3	16
	%	**1.0**	**3.2**	**3.4**	**1.6**	**2.2**
Recency	Count	1	0	0	4	5
	%	**0.5**	**0.0**	**0.0**	**2.2**	**0.7**
Experience	Count	7	11	17	13	48
	%	**3.5**	**8.8**	**8.2**	**7.0**	**6.7**
Complacent/careless	Count	5	0	10	13	28
	%	**2.5**	**0.0**	**4.8**	**7.0**	**3.9**
Training	Count	8	5	9	2	24
	%	**4.0**	**4.0**	**4.3**	**1.1**	**3.3**
Get home itis	Count	0	1	4	0	5
	%	**0.0**	**0.8**	**1.9**	**0.0**	**0.7**
Workload - individual/task level	Count	10	2	6	3	21
	%	**5.0**	**1.6**	**2.9**	**1.6**	**2.9**
Misinformation	Count	1	1	1	3	6
	%	**0.5**	**0.8**	**0.5**	**1.6**	**0.8**
Unqualified for task	Count	0	0	0	1	1
	%	**0.0**	**0.0**	**0.0**	**0.5**	**0.1**
Time pressure	Count	7	3	4	2	16
	%	**3.5**	**2.4**	**1.9**	**1.1**	**2.2**
Non-task related stress	Count	2	3	0	0	5
	%	**1.0**	**2.4**	**0.0**	**0.0**	**0.7**
Workload - commercial pressure	Count	7	3	2	3	15
	%	**3.5**	**2.4**	**1.0**	**1.6**	**2.1**
Money/ financial considerations	Count	2	1	1	2	6
	%	**1.0**	**0.8**	**0.5**	**1.1**	**0.8**
Adaptation to risky situation	Count	1	4	5	1	11
	%	**0.5**	**3.2**	**2.4**	**0.5**	**1.5**
Supervisor inadequacy	Count	1	0	1	1	3
	%	**0.5**	**0.0**	**0.5**	**0.5**	**0.4**
Systems - unsafe eg unalerted See and Avoid	Count	0	0	1	0	1
	%	**0.0**	**0.0**	**0.5**	**0.0**	**0.1**
Systems - equipment	Count	5	2	4	3	14
	%	**2.5**	**1.6**	**1.9**	**1.6**	**2.0**
Systems procedures - do not ensure safety	Count	6	4	4	2	16
	%	**3.0**	**3.2**	**1.9**	**1.1**	**2.2**
Systems procedures - not complied with (unwitting)	Count	2	1	4	3	10
	%	**1.0**	**0.8**	**1.9**	**1.6**	**1.4**
Systems procedures - interrupt/disconnect/fail	Count	3	1	1	0	5
	%	**1.5**	**0.8**	**0.5**	**0.0**	**0.7**
Wilful violation	Count	1	0	2	2	5
	%	**0.5**	**0.0**	**1.0**	**1.1**	**0.7**
Morale	Count	1	0	0	0	1
	%	**0.5**	**0.0**	**0.0**	**0.0**	**0.1**
Managerial - change implementation	Count	0	0	0	1	1
	%	**0.0**	**0.0**	**0.0**	**0.5**	**0.1**
Concentration	Count	0	0	1	0	1
	%	**0.0**	**0.0**	**0.5**	**0.0**	**0.1**
Other	Count	0	1	1	0	2
	%	**0.0**	**0.8**	**0.5**	**0.0**	**0.3**
Systems procedures – not done	Count	13	4	13	6	36
	%	**6.5**	**3.2**	**6.3**	**3.2**	**5.0**
No secondary contributory factor identified	Count	93	68	101	107	369
	%	**46.7**	**54.4**	**48.6**	**57.8**	**51.5**
Total	Count	199	125	208	185	717
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

APPENDIX G - Primary defence across the four flight categories

Primary Defence		Flight Category RPT	Charter	Aerial	Private	Total
Optimising violation	Count	1	2	1	1	5
	%	**0.5**	**1.6**	**0.5**	**0.5**	**0.7**
Recency	Count	2	0	3	2	7
	%	**1.0**	**0.0**	**1.5**	**1.1**	**1.0**
Pilot skills	Count	30	23	44	44	141
	%	**14.8**	**18.4**	**22.1**	**24.2**	**19.9**
Culture towards safety related issues	Count	5	0	2	0	7
	%	**2.5**	**0.0**	**1.0**	**0.0**	**1.0**
Low probability of risk manifestation	Count	7	6	11	12	36
	%	**3.4**	**4.8**	**5.5**	**6.6**	**5.1**
Good lookout	Count	5	9	18	18	50
	%	**2.5**	**7.2**	**9.0**	**9.9**	**7.1**
Procedure	Count	32	13	16	16	77
	%	**15.8**	**10.4**	**8.0**	**8.8**	**10.9**
Limit exceeded not safety critical/ benign environ	Count	8	7	5	12	32
	%	**3.9**	**5.6**	**2.5**	**6.6**	**4.5**
Third party notification - flight crew	Count	17	9	3	0	29
	%	**8.4**	**7.2**	**1.5**	**0.0**	**4.1**
Third party notification - ATS	Count	15	4	13	14	46
	%	**7.4**	**3.2**	**6.5**	**7.7**	**6.5**
Third party notification – aircraft system stick shaker	Count	2	0	0	0	2
	%	**1.0**	**0.0**	**0.0**	**0.0**	**0.3**
Third party notification - aircraft system TCAS	Count	12	0	2	0	14
	%	**5.9**	**0.0**	**1.0**	**0.0**	**2.0**
Third party notification - other	Count	3	8	6	10	27
	%	**1.5**	**6.4**	**3.0**	**5.5**	**3.8**
Redundant information system	Count	18	10	3	5	36
	%	**8.9**	**8.0**	**1.5**	**2.7**	**5.1**
Aircraft system performance capability	Count	7	2	5	6	20
	%	**3.4**	**1.6**	**2.5**	**3.3**	**2.8**
Conservative practice	Count	7	1	4	7	19
	%	**3.4**	**0.8**	**2.0**	**3.8**	**2.7**
None	Count	26	28	57	27	138
	%	**12.8**	**22.4**	**28.6**	**14.8**	**19.5**
Third party assistance	Count	3	1	2	5	11
	%	**1.5**	**0.8**	**1.0**	**2.7**	**1.6**
Third party notification - aircraft system other	Count	3	1	4	3	11
	%	**1.5**	**0.8**	**2.0**	**1.6**	**1.6**
Total	Count	203	125	199	182	709
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

APPENDIX H - Secondary defence across the four flight categories

Secondary Defence		Flight Category				Total
		RPT	Charter	Aerial	Private	
Recency	Count	1	0	3	2	6
	%	**0.5**	**0.0**	**1.5**	**1.1**	**0.8**
Pilot skills	Count	11	14	7	9	41
	%	**5.4**	**11.2**	**3.5**	**4.9**	**5.8**
Culture towards safety related issues	Count	1	1	0	0	2
	%	**0.5**	**0.8**	**0.0**	**0.0**	**0.3**
Low probability of risk manifestation	Count	0	1	1	0	2
	%	**0.0**	**0.8**	**0.5**	**0.0**	**0.3**
Good lookout	Count	4	1	1	0	6
	%	**2.0**	**0.8**	**0.5**	**0.0**	**0.8**
Procedure	Count	19	3	6	8	36
	%	**9.4**	**2.4**	**3.0**	**4.4**	**5.1**
Limit exceeded not safety critical/ benign environ	Count	2	1	1	3	7
	%	**1.0**	**0.8**	**0.5**	**1.6**	**1.0**
Third party notification - flight crew	Count	9	0	2	0	11
	%	**4.4**	**0.0**	**1.0**	**0.0**	**1.6**
Third party notification – ATS	Count	5	1	1	1	8
	%	**2.5**	**0.8**	**0.5**	**0.5**	**1.1**
Third party notification - aircraft system TCAS	Count	0	0	1	0	1
	%	**0.0**	**0.0**	**0.5**	**0.0**	**0.1**
Third party notification – other	Count	1	2	0	1	4
	%	**0.5**	**1.6**	**0.0**	**0.5**	**0.6**
Redundant information system	Count	6	4	6	2	18
	%	**3.0**	**3.2**	**3.0**	**1.1**	**2.5**
Aircraft system performance capability	Count	1	2	6	1	10
	%	**0.5**	**1.6**	**3.0**	**0.5**	**1.4**
Conservative practice	Count	4	2	2	1	9
	%	**2.0**	**1.6**	**1.0**	**0.5**	**1.3**
Third party assistance	Count	0	0	0	2	2
	%	**0.0**	**0.0**	**0.0**	**1.1**	**0.3**
Third party notification - aircraft system other	Count	2	0	0	0	2
	%	**1.0**	**0.0**	**0.0**	**0.0**	**0.3**
No secondary defence identified	Count	137	93	162	152	544
	%	**67.5**	**74.4**	**81.4**	**83.5**	**76.7**
Total	Count	203	125	199	182	709
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

APPENDIX I - Subsequent defence across the four flight categories

Subsequent Defence		Flight Category				Total
		RPT	Charter	Aerial	Private	
Developed procedure	Count	1	1	0	0	2
	%	**0.5**	**0.8**	**0.0**	**0.0**	**0.3**
Supervisor intervention	Count	2	0	3	1	6
	%	**1.0**	**0.0**	**1.5**	**0.5**	**0.8**
Further training	Count	4	4	3	4	15
	%	**2.0**	**3.2**	**1.5**	**2.2**	**2.1**
Learned from experience	Count	4	3	10	2	19
	%	**2.0**	**2.4**	**5.0**	**1.1**	**2.7**
Support development of safety culture	Count	1	2	1	0	4
	%	**0.5**	**1.6**	**0.5**	**0.0**	**0.6**
Additional equipment fitted	Count	0	1	1	0	2
	%	**0.0**	**0.8**	**0.5**	**0.0**	**0.3**
No subsequent defence given	Count	191	115	183	177	666
	%	**94.1**	**91.3**	**91.0**	**96.2**	**93.3**
Total	Count	203	126	201	184	714
	%	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

APPENDIX J - Media release

Australian Government

Australian Transport Safety Bureau

Media Release

2004/14
June 2004

ATSB Aviation Safety Survey – Common Flying Errors

The ATSB's aviation safety survey of commercial pilots, *Common Flying Errors*, has revealed that, violations of standard operating procedures were more prevalent in general aviation and were involved in 11.8% of all events.

The survey asked pilots to identify the main factors contributing to errors and the defences they used to recover. Most errors occurred en route, distantly followed by flight preparation errors.

All categories of pilot experienced errors while executing procedures en route, such as not completing their landing checklist, and misprocessing information from their operational environment, such as an unexpected decline in weather conditions. Most identified errors involving mishandling as a concern, such as heavy landing; misconfiguration, such as landing with the flap setting one less than configured for; and misprocessing navigational information, such as an incorrect GPS identifier.

The contributing factor identified by all categories of pilot as enhancing the likelihood of error was lack of pilot experience. Failing to complete procedures, such as not cross-checking figures, and experiencing problems with systems equipment, such as frequency congestion, also exacerbated errors in most categories.

Operational personnel across all flight categories indicated that there was frequently no defence present to protect against the error. When a defence was available, pilot skills and implementing procedures predominantly enhanced error recovery. Very few pilot responses indicated that a defence had been employed after the event to reduce the potential of recurrence.

Overall:

- violation of standard operating procedures was involved in 11.8% of events;
- wilfully risky activities were present in 3.2% of error events;
- in 2.1% of reported events an accident occurred;
- 9.1% of respondents were involved in a concern relating to a mid-air collision, most of which involved no warning (unalerted confliction 6.1%).

Some caution is required when interpreting results because considerable amounts of data were missing. The survey conveys the opinion of pilots and not the opinion of the ATSB. Results do not suggest that aviation is more at risk of error than other transport activities.

The full Aviation Safety Survey – Common Flying Errors is available on the ATSB website: www.atsb.gov.au

MEDIA CONTACT: PETER SAINT B: (02) 6274 6590; M: 0408 497 016

15 Mort Street, Canberra City ACT 2601 • PO Box 967, Civic Square ACT 2608 Australia
Telephone: 02 6274 6590 • Facsimile: 02 6247 3117
24 hours: 1800 621 372 • www.atsb.gov.au
ABN 86 267 354 017

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