Department of Transport and Communications

Bureau of Air Safety Investigation

A Review of Air Safety Occurrences During the Introduction of AMATS

(Airspace Management and Air Traffic Services)

December 1991 to April 1992

RESEARCH PROJECT
RP/91/12

BASI
Bureau of Air Safety Investigation

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under the provisions of Air Navigation Regulation 283

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BASI does not have the resources to carry out a full cost-benefit analysis of every recommendation. The cost of any recommendation must always be balanced against its benefits to safety, and aviation safety involves the whole community. Such analysis is a matter for the CAA and the industry.

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This report was produced by the Bureau of Air Safety Investigation (BASI), PO Box 967, Civic Square ACT 2608.

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EXECUTIVE SUMMARY

Changes to the airspace management system which were introduced on the 12th of December 1991, firmly established the responsibility with the pilot for aircraft collision avoidance outside controlled airspace, and for avoiding penetration of controlled airspace. In doing so it was a radical modification to the Australian Air Traffic Services (ATS) system.

In view of significance of the changes, the Bureau of Air Safety Investigation (BASI) undertook an evaluation. This evaluation took the form of the investigation of all occurrences which were deemed to be related to the AMATS changes in a four month period from the 12th of December 1991. Additionally a questionnaire was disseminated in the BASI Journal and deidentified CAIR reports were used to supplement the information available.

In the four month period, 147 occurrences were categorised as AMATS related. The Bureau received 169 questionnaires and 51 CAIR reports.

The results indicated that the majority of occurrences were initiated by an aircraft operating under visual flight rules (67%). The incidents involved all types of aircraft operation including 34 occurrences in which regular passenger transport aircraft were involved.

The most frequent occurrences were penetrations of controlled airspace and incidents which resulted from a lack of operational information. Regardless of the type of occurrence the majority were attributed to pilot aircrew's failure to follow approved procedures. The questionnaire and CAIR data reflected the findings of the occurrence data.

Despite a high reported understanding of the principles and implications of the AMATS changes, the data available illustrates basic errors in the adoption of AMATS procedures. These errors may reflect the inability of pilots to put the principles associated with the AMATS changes into practice, such as being able to resolve three dimensional traffic conflicts. Similarly the CAA's emphasis on restricting radio communications and relying on see-and-avoid principles appears to have been followed by VFR pilots, but led to a number of occurrences.

The introduction of AMATS placed more responsibility on the component of the system with the least skills and training, ie the VFR pilot. The safety of the aviation system under AMATS can only be achieved if all pilots and ATS personnel comply with the standards and procedures. Even a small number who fail to comply can have a detrimental effect on safety. This is particularly relevant as the "safety net" is limited to procedures. It would be appropriate to refine the system to ensure that it is tolerant of the errors of pilots and ATS personnel. This error tolerance can be achieved through education, procedures, documentation and airspace design which aim to increase pilot compliance and reduce workload.

BASI notified the CAA of particular concerns during the data collection period and also provided input to CAA publications which focused on the changes, specially AIC H9/92. Such collaboration ensured that any major safety concerns were addressed immediately. Through articles in the BASI Journal, the evaluation team kept the aviation community abreast of BASI's findings and gave advice regarding good practice whilst operating in the AMATS environment.

No recommendations are associated with this report. Issues which would have warranted recommendations have already been addressed by the CAA. For example the design philosophy used for the ICAO airspace changes introduces an increased number of calls during operations in MTAFs. A number of recommendations which would have emanated from this report have already been presented to the CAA following the study into violations of controlled airspace, for example; the requirement for an ongoing pilot education strategy and improved charting.

Chapter 1

BACKGROUND

Changes to the airspace management system, which were introduced on the 12th December 1991, were perhaps the most radical modification to the Australian Air Traffic Services (ATS) system to date. The changes which became known as AMATS, an acronym for the Airspace Management and Air Traffic Services project, were the first in a four-year period of change towards the Australian Advanced Air Traffic System (TAAATS).

The changes implemented on the 12th of December 1991 incorporated:

(a) new Visual Meteorological Conditions (VMC) minima;
(b) International Civil Aviation Organisation (ICAO) cruising levels;
(c) the abolition of full reporting Search and Rescue (SAR) as an applicable procedure for Visual Flight Rules (VFR) flight;
(d) no requirement for VFR aircraft to lodge flight details with the Civil Aviation Authority (CAA) unless intending to operate in controlled airspace (CTA) above 10,000 feet (ft);
(e) the establishment of Common Traffic Area Frequencies (CTAFs);
(f) the establishment of Mandatory Traffic Area Frequencies (MTAFs);
(g) clearance to operate in controlled airspace obtained direct from Air Traffic Control (ATC); and
(h) hand-held radio use Outside Controlled Airspace (OCTA) below 5000ft by pilots of aircraft whose aircraft would not previously require the carriage and use of radio.

The philosophy behind the changes was to give VFR pilots the responsibility for aircraft collision avoidance outside controlled airspace and for avoiding penetration of controlled airspace.

This report details the results of a study undertaken by the Bureau of Air Safety Investigation which evaluated the AMATS changes.

Chapter 2

METHOD

Four methods of data collection were used to meet the project's objectives. These were: investigation of AMATS related occurrences; a survey which was promulgated with the BASI Journal (Number 10, December 1991); deidentified Confidential Aviation Incident Reporting (CAIR) reports; and visits and flights to various locations in which the operation of AMATS procedures were assessed by air safety investigators (ASIs). The collation and analysis of the data was undertaken by a specially formed team based in BASI's Central Office in Canberra.

1. Investigation of AMATS related occurrences

Prior to the 12th of December, an ASI in each field office was designated as an AMATS coordinator who would conduct any incident or accident investigation in which the newly introduced AMATS procedures were thought to be involved. The ramifications of the AMATS changes were drawn to the attention of all ASIs, and the AMATS coordinator in particular.

Specially designed forms were produced for the exercise, with the details of the occurrence being noted (eg location, airspace, aircraft types, flight category) along with descriptive factors (eg type of occurrence, attributed causes).

The data collection period was conducted between the 12th of December, 1991 and the 9th of April, 1992.

2. AMATS Survey

A questionnaire was developed which aimed to elicit information in addition to that which would be collected through occurrence investigation. The questionnaire gave an opportunity for respondents to provide descriptions of occurrences or situations which they had encountered, and rate their awareness and understanding of the implications of the AMATS changes. An evaluation of the impact of the AMATS changes on safety and an assessment of how effectively the CAA had educated the aviation community regarding the reorganisation of the ATS system could then be conducted.

The option was available for the questionnaire to be treated as a CAIR report to protect the identity of the respondent. This was ensured by all the respondents returning the questionnaire to the CAIR office. Questionnaires were then distributed to the AMATS evaluation team once those which were to be treated as CAIR reports had been deidentified.

The survey was distributed in the BASI Journal (Number 10) which was distributed to all licence holders in the middle of December 1991. Questionnaire forms returned to BASI were coded and placed on a database for analysis.

The data collection period ran until the 15th of May, 1992.

3. CAIR Reports

Reports which were sent to CAIR which involved AMATS were also entered into a database after the normal deidentification process.

4. Field visits and flights

BASI investigators made flights within Western Australia, New South Wales and Victoria with the aim of determining at first hand how pilots and Air Traffic Service operators handled the AMATS procedures.

In the general course of their investigatory duties ASIs were also asked to inquire about the implementation and functioning of AMATS. These accounts were also sent to the AMATS evaluation team in Canberra.

5. Dissemination of Information

The information was collated and when necessary the AMATS evaluation team informed the CAA of aspects which were of particular concern. BASI also provided input to CAA publications which focused on the changes, such as AIC H9/92. Such collaboration ensured that any major safety concerns could be addressed immediately by the CAA.

In endeavours to keep the aviation community abreast of BASI's findings and concerns, articles were published in BASI Journal 11 which was distributed in March 1992 and Journal 12 in June 1992.

Chapter 3

Results

At the conclusion of the data collection period, 147 occurrence reports, 51 CAIR reports and 169 AMATS questionnaire forms were entered into the databases. For the purposes of analysis, the CAIR reports were treated in same way as the AMATS survey forms.

As the number of aircraft movements were unknown it was not possible to normalise the data. The results are therefore presented as pure numbers.

3.1 OCCURRENCE INVESTIGATION

Table 1 indicates the number of occurrences between the 12th of December 1991 and the 9th of April 1992 which were identified by BASI as AMATS related. All the occurrences were incidents. The AMATS related occurrences declined in both actual number and as a percentage of all ATS related occurrences during this period (see Appendix A).

Table 1

AMATS OCCURRENCES AS A PERCENTAGE OF ALL ATS RELATED OCCURRENCES

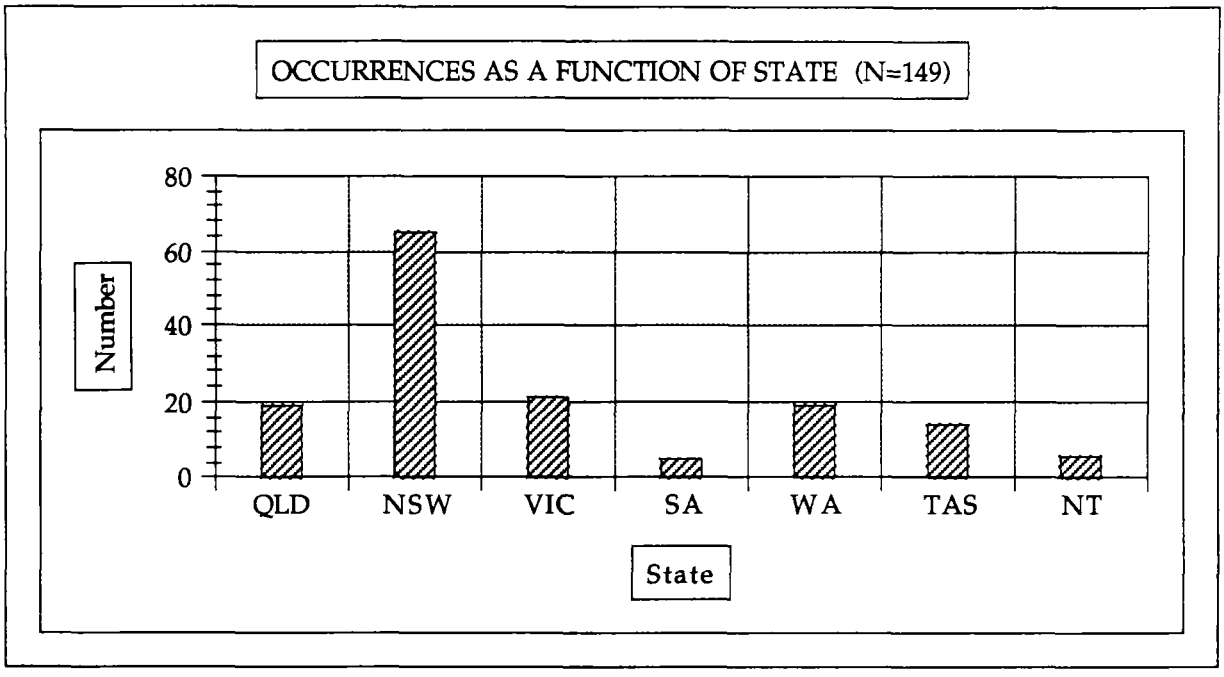
MONTH	NUMBER OF AMATS INCIDENTS	AMATS OCCURRENCES AS A PERCENTAGE OF ALL ATS RELATED OCCURRENCES
December	37	40%
January	39	34%
February	27	25.5%
March	32	21.5%
April	14	21%

Note: December and April are incomplete, ie December covers 12th to 31st, April 1st to 9th.

ATS related occurrences are all those incidents which impact on functioning of the ATS system, and consequently include operational errors or omissions on the part of ATCs, FSOs and pilots.

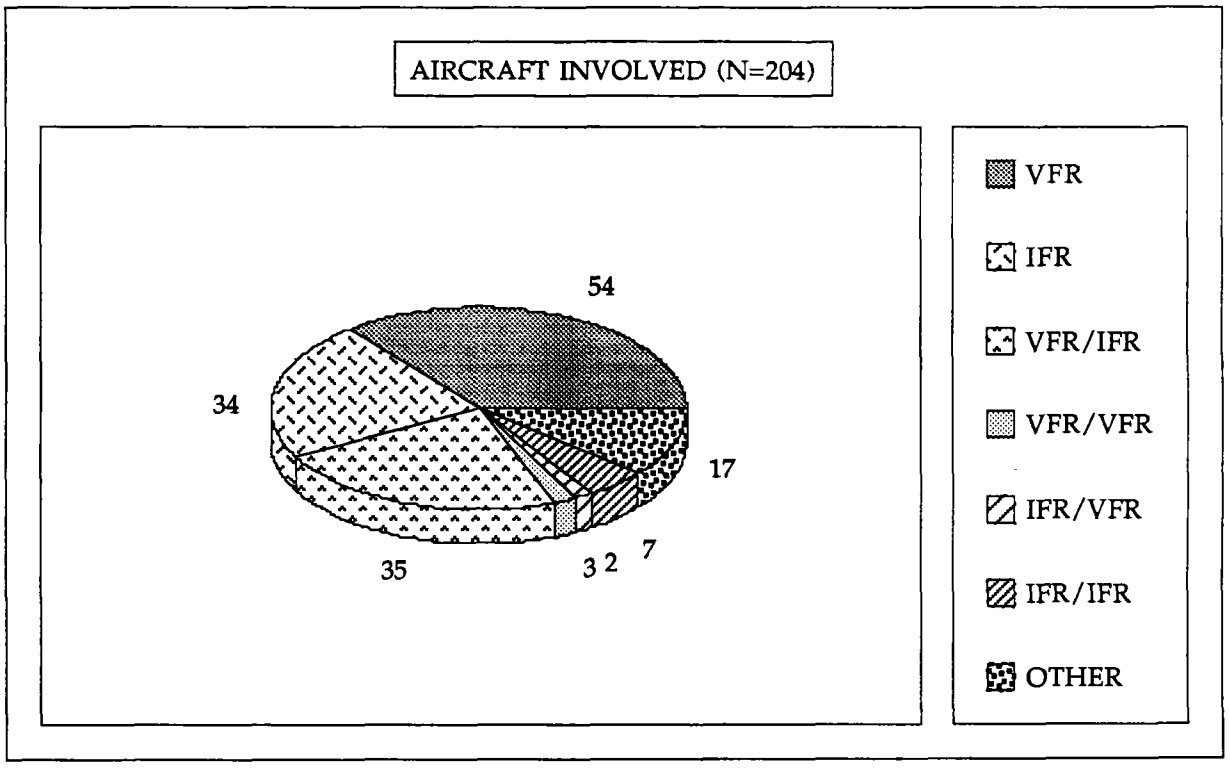
The greatest number of AMATS related incidents occurred in New South Wales (n=64). Victoria, Queensland and Western Australia had roughly equal numbers of incidents in which the AMATS procedures were involved (see Table 2).

Table 2



When the aircraft were classified according to their flight category, ie visual flight rules (VFR) or instrument flight rules (IFR), 102 aircraft operating under VFR and 88 IFR aircraft were involved. In 14 cases the aircraft was unknown. In this analysis, it is perhaps more meaningful to consider the aircraft which was deemed to have initiated the incident if more than one aircraft was involved. Using the criterion, 94 aircraft operating under VFR and 46 aircraft under IFR were implicated. Table 3 presents this information in greater detail.

Table 3

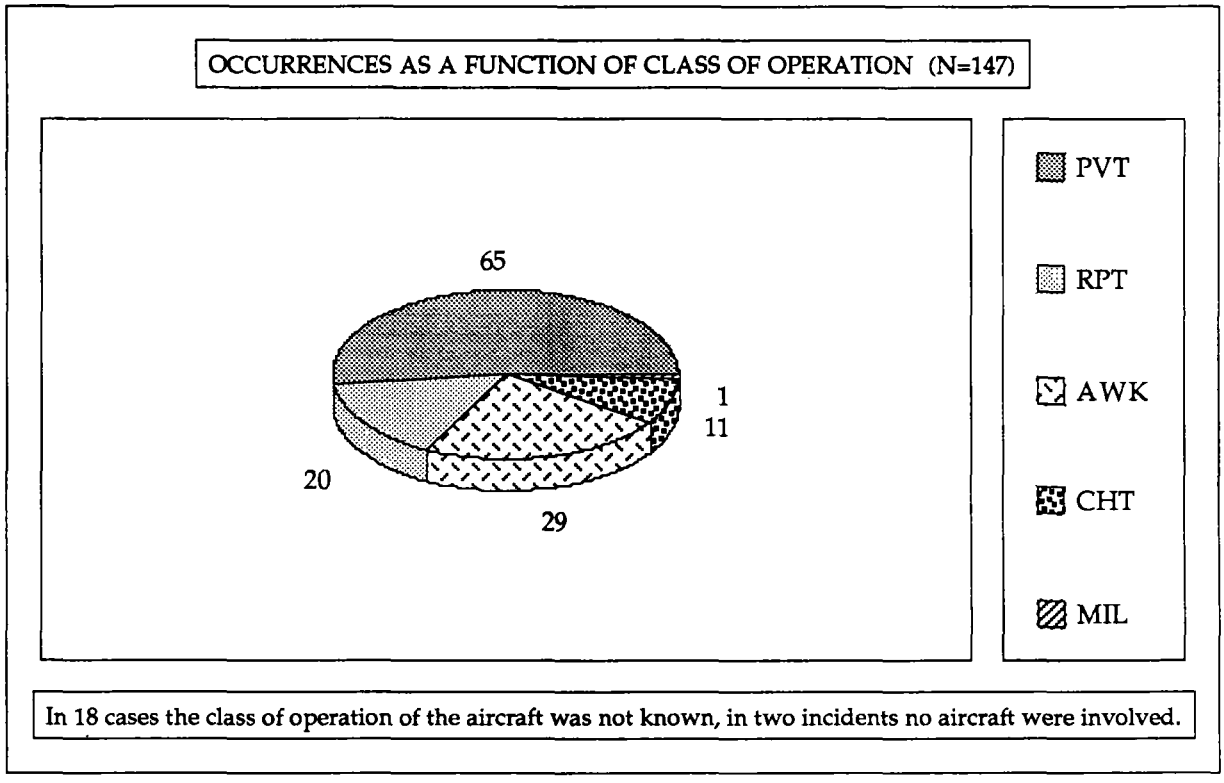


Note: In the case of incidents in which two aircraft were involved, the flight category indicated first is the category of the aircraft deemed to have initiated the occurrence.

Key:		
	VFR	VFR aircraft involved
	IFR	IFR aircraft involved
	VFR/IFR	VFR and an IFR aircraft involved, the VFR aircraft was deemed to have initiated the occurrence
	VFR/VFR	Two VFR aircraft involved, one of which was deemed to have initiated the occurrence
	IFR/VFR	IFR and VFR aircraft involved, the IFR aircraft was deemed to have initiated the occurrence
	IFR/IFR	Two IFR aircraft involved, one of which was de;emed to have initiated the occurrence
	OTHER	An unknown combination of aircraft involved, or more than two aircraft involved in the reported occurrence

Sixty-five (44%) of the aircraft which initiated the occurrence were operating privately, 29 (20%) were engaged in aerial work and 20 (14%) in regular public transport operations (RPT) (see Table 4). When all the aircraft involved in the occurrences were categorised according to the class of operation, 70 aircraft (34%) were operating privately, 57 (28%) of aircraft were RPT and 34 (17%) were conducting aerial work (see Table 5).

Table 4

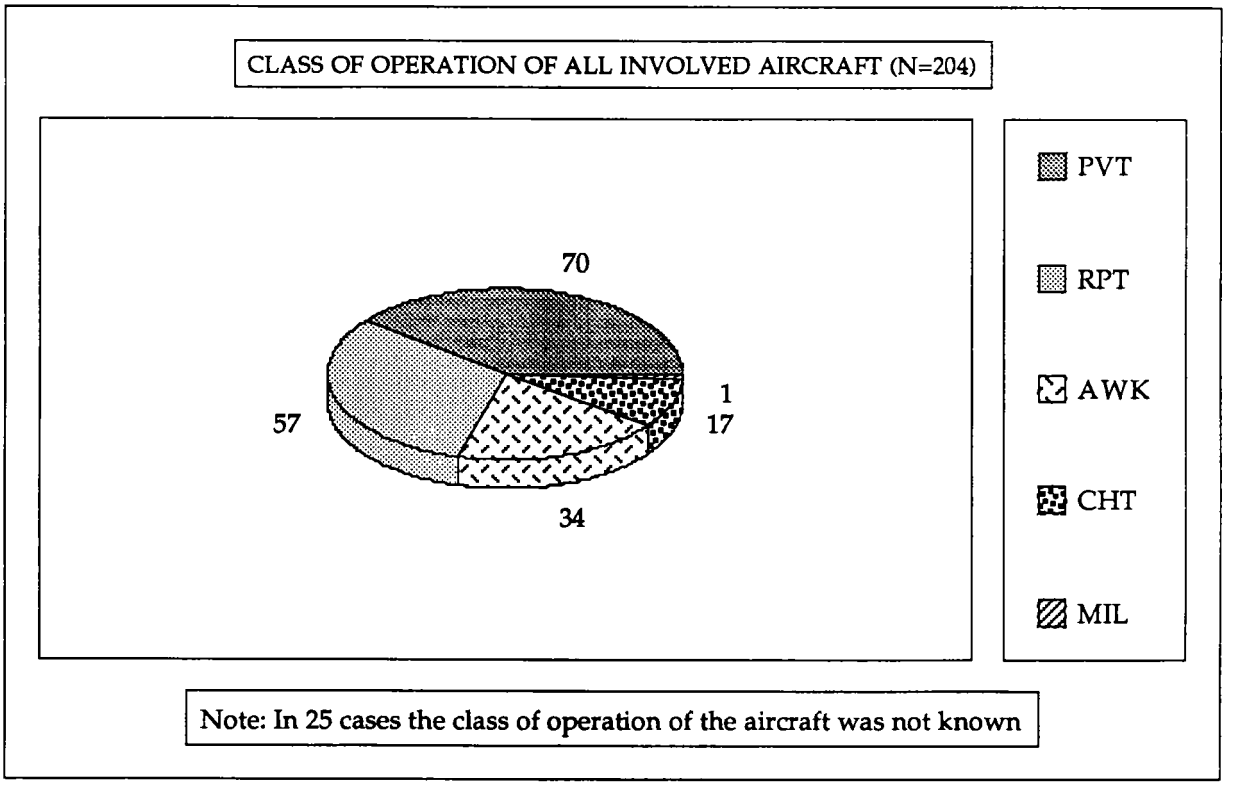


Key: In a number of incidents reported, the Bureau was unable to identify the second/third aircraft involved. In such cases, it has been impossible to classify aircraft according to a number of criteria, eg in Table 4 18 cases were unknown.

Two events categorised within the study as incidents were situations which occurred prior to a flight, (eg late arrival of ERSA) consequently no aircraft was involved.

PVT	Private	RPT	Regular Passenger Transport
AWK	Aerial Work	CHT	Charter
MIL	Military		

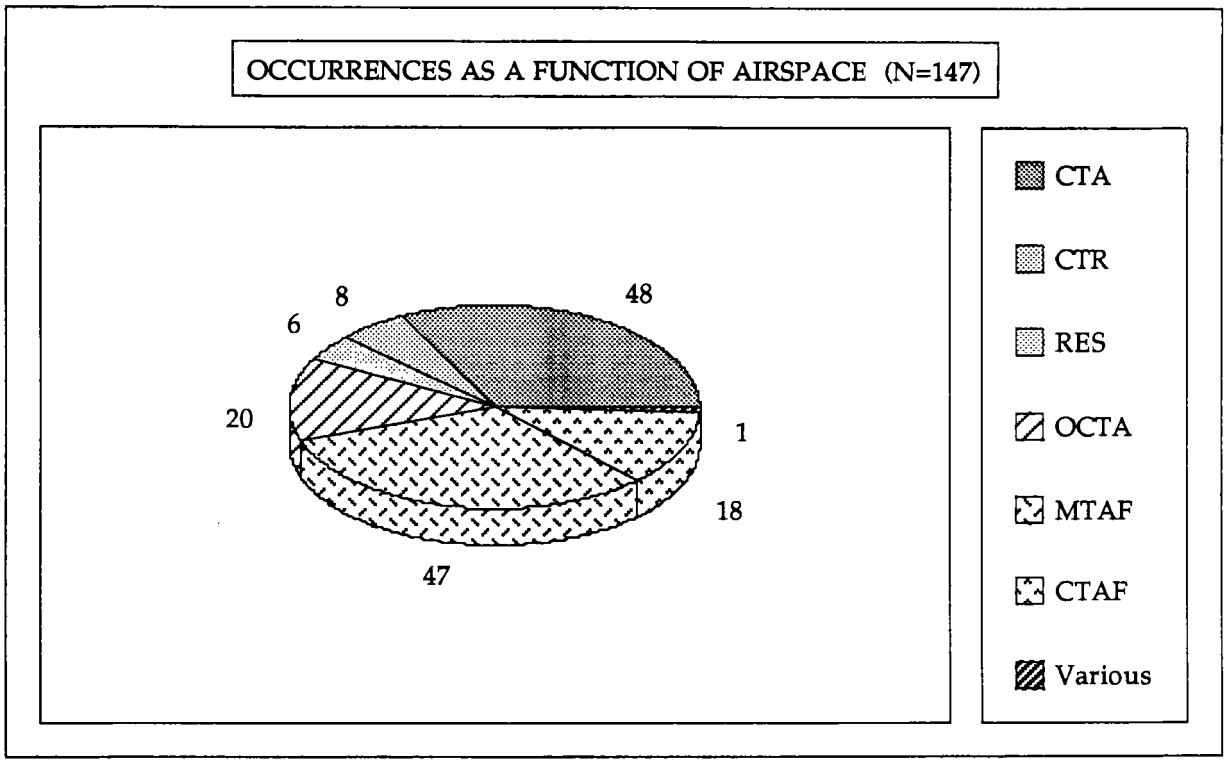
Table 5



Key: PVT Private RPT Regular Public Transport
AWK Aerial work CHT Charter MIL Military

Table 6 categorises incidents according to the airspace in which they occurred. The greater number of incidents occurred in control areas (CTA), mandatory traffic advisory frequency (MTAFs) and common traffic advisory frequency (CTAFs).

Table 6



Note: In two incidents no aircraft were involved.

Key:				
	CTA	Control area	CTR	Control zone
	RES	Restricted area	OCTA	Outside controlled airspace
	MTAF	Mandatory Traffic Advisory Frequency	CTAF	Common Traffic Advisory Frequency

Occurrences classified as lack of operational information[1], penetrations of control areas and airmisses OCTA[2] accounted for the vast majority of the incidents under review (see Table 7). In order to more fully appreciate the nature of the incidents, it is necessary to consider the factors which contributed to the incidents.

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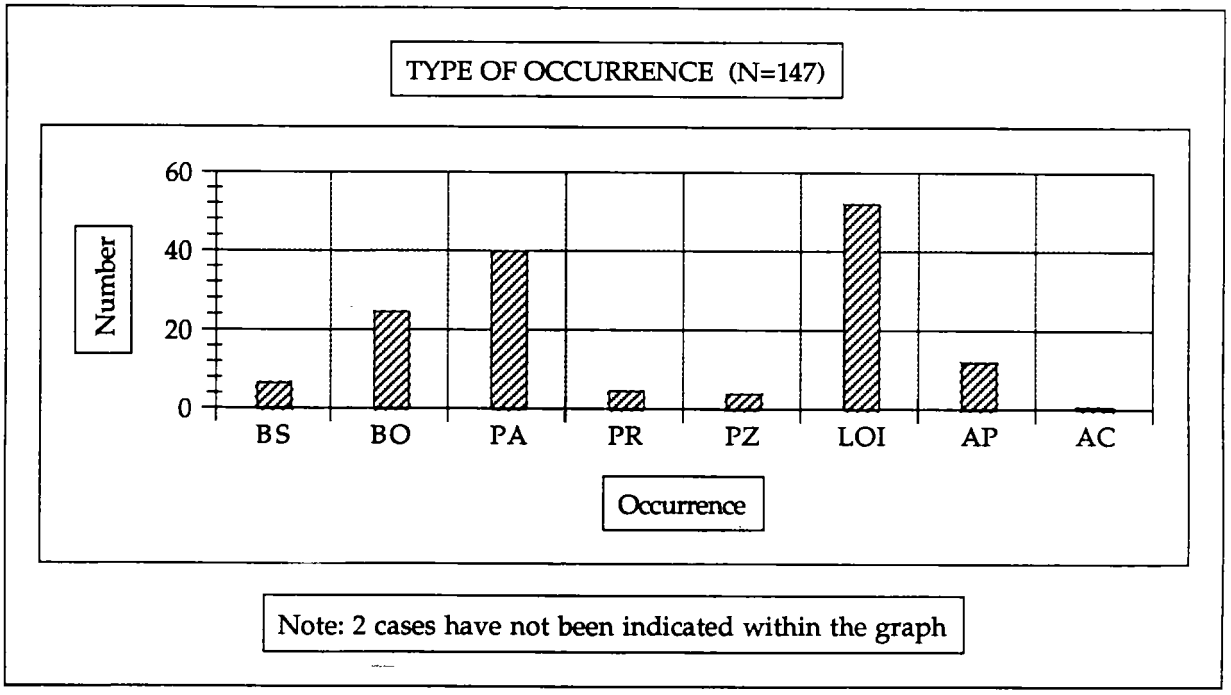
1 For example: Aircraft not providing a position report following a broadcast from an aircraft whilst on a potentially conflicting course.

2 No separation standards exist outside controlled airspace, therefore BASI has a classification system to determine the risk of collision (see Appendix C for airmiss classifications). If there is believed to be a potential for a collision then the occurrence is defined as an airmiss.

Table 7



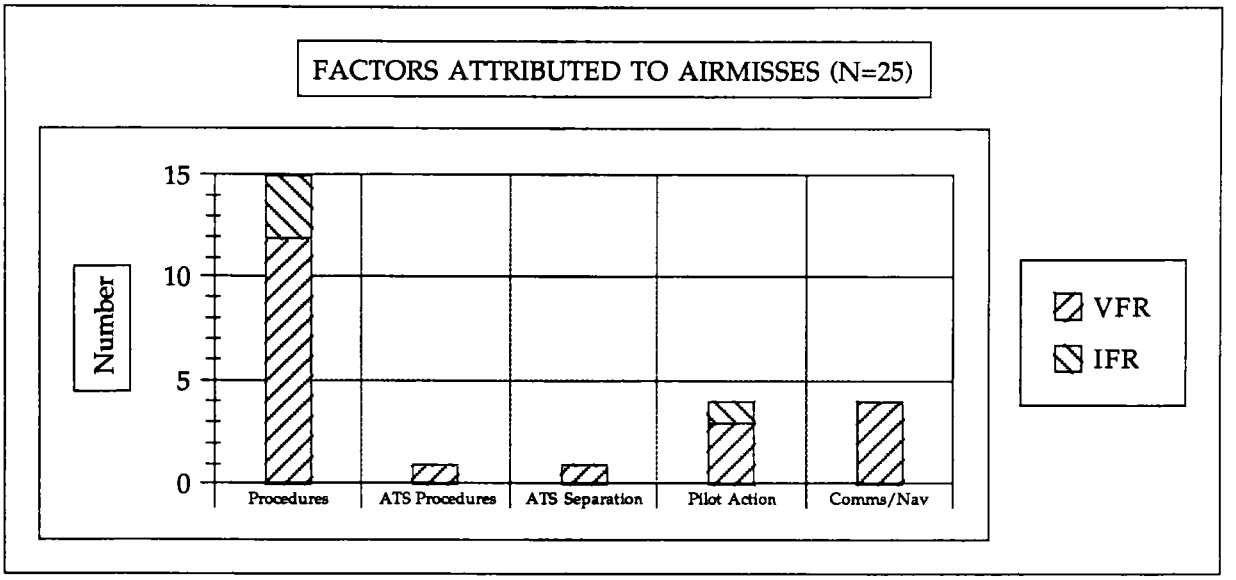
Key:				
	BS	Breakdown in separation	BO	Airmiss OCTA
	PA	Penetration of control area	PR	Penetration of restricted area
	PZ	Penetration of control zone	LOI	Lack of operational information
	AP	Aircrew non-compliance with procedures	AC	Aircrew non-compliance with a clearance

3.1.1 Type of Incident

3.1.1.1 Airmisses

The failure of pilots to adopt the correct AMATS procedures contributed to 60% of airmisses (see Table 8). The majority of airmisses involved an aircraft operating VFR and one IFR (see Appendix B(i)). Table 8 classifies occurrences according to which aircraft was determined to have initiated the occurrence, as can be seen in the greater number of cases this was believed to be a VFR pilot (see Appendix C for airmiss classifications). An example of an airmiss investigated by BASI is given in Insert 1.

Table 8



Key:		
	Procedures	Aircrew failure to follow approved procedures
	ATS Procedures	ATS failure to follow approved procedures
	ATS Separation	ATS failure to provide separation
	Pilot Action	Pilot Initiated Action
	Comms/Nav	Communication/navigation equipment failure
	VFR	VFR pilot determined to have initiated the occurrence
	IFR	IFR pilot determined to have initiated the occurrence

Insert 1 B/925/8106 Rottnest Island, WA 9th February 1992

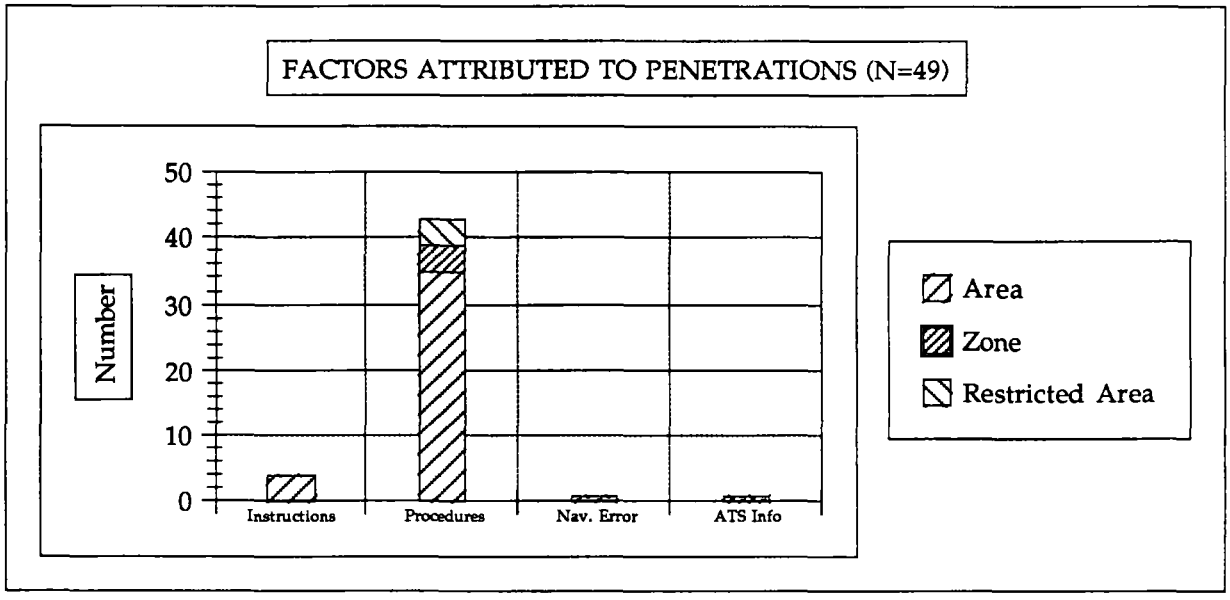
At 15DME Perth, a Britten-Norman Islander changed to Rottnest Island CTAF (126.0 MHZ) and made the required inbound calls. The aircraft received no acknowledgment to these calls. On descent at 1300 feet, the pilot of the Islander spotted a Cessna 210 which appeared on the port side and crossed in front and approximately 100 feet above the Islander. The pilot of the Islander took evasive action.

According to the BASI categorisation of risk associated with airmisses, this incident was classified as "critical".

3.1.1.2 Penetrations of Controlled Airspace

Table 9 indicates the factors which were attributed during the investigation of penetrations. In the majority of cases the incident occurred because the pilot failed to follow approved procedures, eg entering controlled airspace without a clearance (see Insert 2 for an example).

Table 9



Key:		
	Procedures	Aircrew failure to follow approved procedures
	Instructions	Aircrew failure to follow approved instructions
	Nav. Error	Navigation error
	ATS Info	ATS failure to provide information
	Area	Penetration of control area
	Zone	Penetration of control zone
	Restricted	Penetration of restricted area

Insert 2 B/921/8116 Rockhampton, QLD 27 March 1992

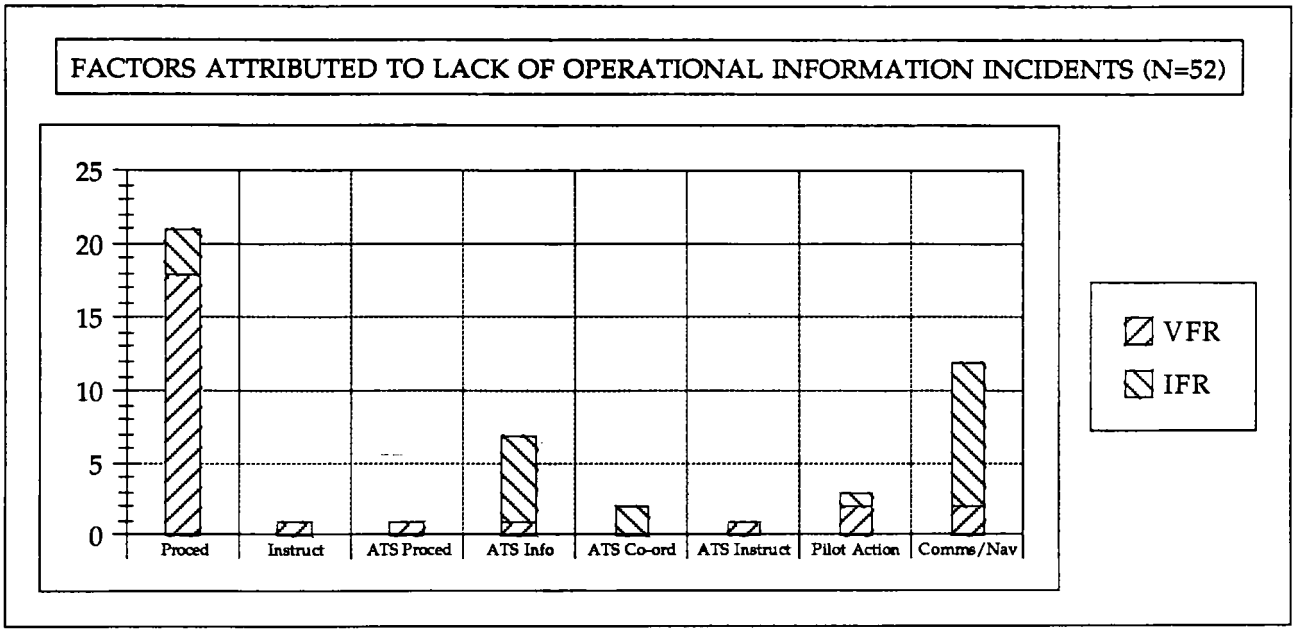
The pilot of an Embraer Bandeirante called Rockhampton Tower at 31 DME Rockhampton on climb to 8000feet for a clearance. The aircraft was actually within the CTA at this time, and was subsequently issued with a clearance. The air traffic controller (ATC) reflected that the pilot documents did not indicate the ATC frequency to use to request an airways clearance and there appeared to be confusion regarding where the boundary of responsibility lay. The investigation determined that there was only a 1000 feet gap between the MTAF and CTA step. Flight Service was not authorised to provide clearances to an aircraft on the ground at Gladstone, such clearance has to be obtained in the climb. Operating through a MTAF, OCTA and CTA which meant that a number of frequency changes were required in a short period of time.

3.1.1.3 Lack of Operational Information (LOI)

Of the 52 lack of operational information (LOI) incidents, 21 were attributed to

failure on the part of a pilot to act in accordance with the AMATS procedures. In the majority of such cases, the incident was initiated by a VFR pilot (see Table 10). As with airmisses, the most commonly occurring aircraft combination was one operating VFR and the other IFR (see Appendix B (ii)). A typical example is given in Insert 3.

Table 10



Key:		
	Procedures	Aircrew failure to follow approved procedures
	Instruct	Aircrew failure to follow instructions
	ATS Proced	ATS failure to follow approved procedures
	ATS Info	ATS failure to provide information
	ATS Co-ord	ATS failure to provide co-ordination
	ATS Instruct	ATS failure to follow approved instructions
	Pilot Action	Pilot Initiated Action
	Comms/Nav	Communication/navigation equipment failure
	VFR	VFR pilot determined to have initiated the occurrence
	IFR	IFR pilot determined to have initiated the occurrence

Insert 3 B/826/8129 Tamworth 65 kms East, NSW 15 March 1992

The pilot of a Piper Navajo operating IFR stated that he commenced descent into Tamworth at 55 nm on the 090 radial, notifying the level change to FIS on Area Frequency prior to leaving 8000 feet (ft) for 6000ft. He received no reply from the other aircraft. On the second radio transmission he called Tamworth for an airways clearance, which was given at 6000 ft due to other IFR traffic. Approximately one minute later, a Cessna 172 operating under visual flight rules requested a clearance at 6500 ft reporting abeam Walcha (Walcha is approximately 40nm from Tamworth on the 080 radial). As the Cessna 172 was tracking from Port Macquarie it was determined that both were on approximately the same track.

The pilot of the Cessna 172 did not respond to any request for positional information made by the Piper Navajo on Area Frequency and it required some effort by the Tamworth controller to establish relative positions and ensure separation in the CTA.

3.1.1.4 Summary

A review AMATS related occurrences indicates that, regardless of the type of incident, the majority of occurrences can be attributed to pilot failure to follow approved procedures.

3.1.2 AMATS Attributed Factors

This section provides information about the apparent failure to adopt the new procedures. Factors were divided into those which were associated with the arrangement of airspace, airspace clearances, traffic information, movement reporting, frequencies, communications and the actual AMATS procedures. Within each factor there were various components, for example: movement reporting may not have been given, may have been inappropriate or confusing. Equally a pilot may not have heard a taxi or inbound call from an aircraft because there may have been interference. While these can be considered in isolation they have also been considered under the category of communications.

When all the factors were considered, problems associated with aircraft movement reporting, traffic information and airways clearances were identified most frequently (see Table 11).

These factors are also considered in relation to the type of airspace within which the incident occurred in Section 3.1.3.

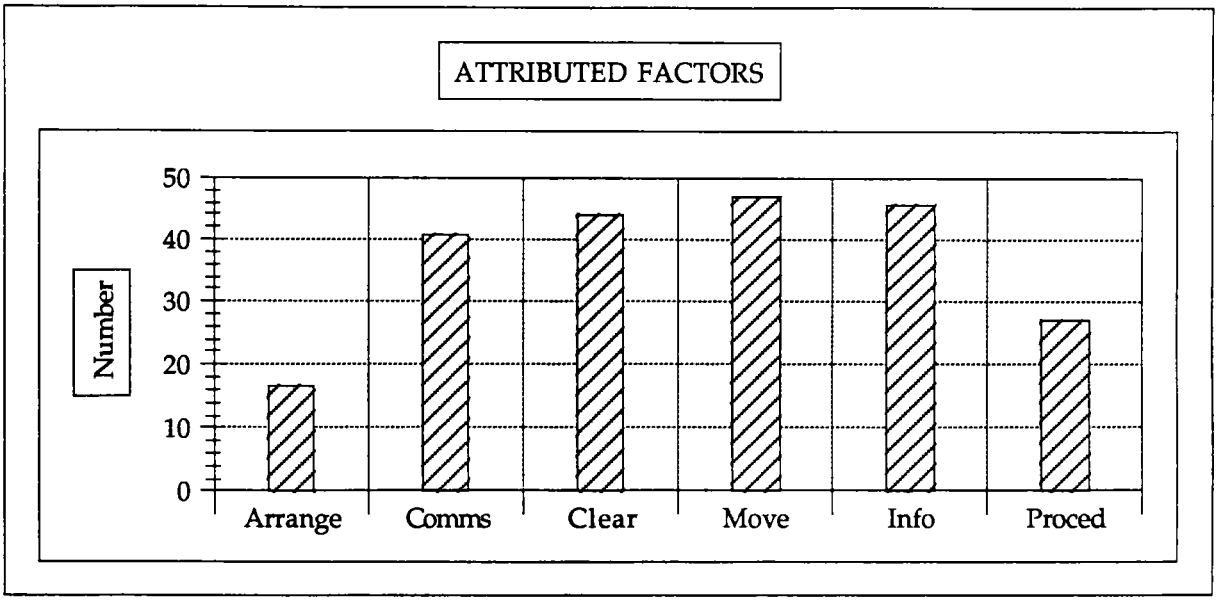
3.1.3 Airspace

In order to more fully appreciate the occurrences, the data has been categorised according to the airspace within which the incident occurred, ie MTAF, CTAF, OCTA and controlled airspace.

3.1.3.1 MTAFs

Table 12 indicates the breakdown of incidents occurring in MTAFs according to the type of occurrence. As can be seen the majority of the incidents were a product of lack of operational information. Appendix B provides a further breakdown according to the type of occurrence and flight category of the aircraft involved. Examples of airmisses are shown in Insert 4 (a further example is given in Appendix E). When MTAF incidents were classified according to location, there was no particular MTAF which dominated the statistics (see Appendix F).

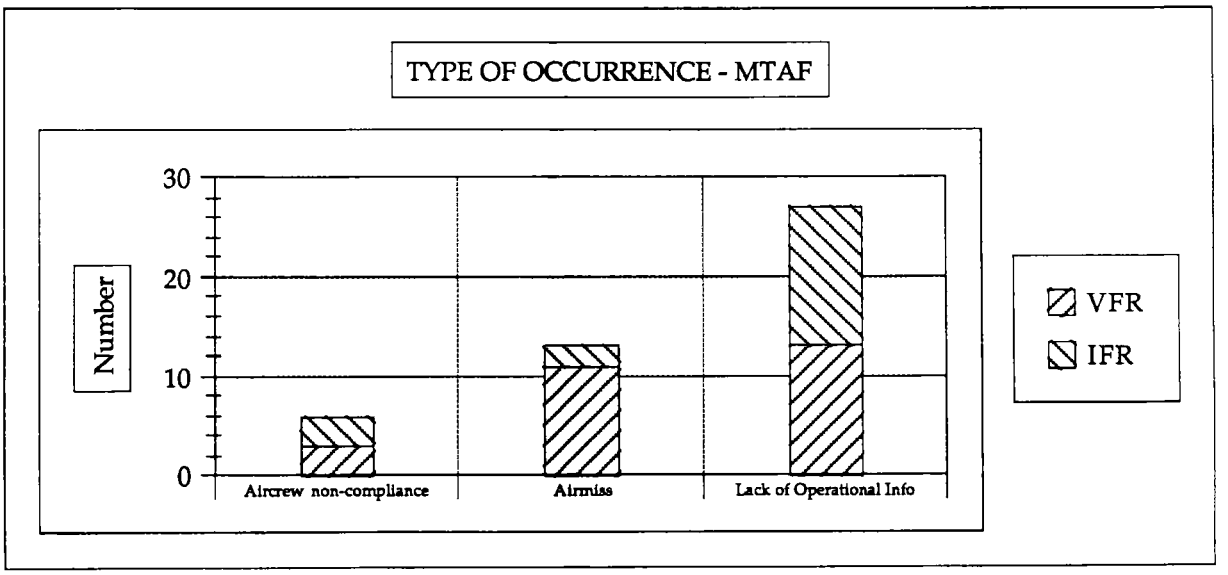
Table 11



Key:				
	Arrange	Airspace Arrangement	Comms	Communications
	Clear	Airspace Clearance	Move	Movement Reporting
	Info	Traffic Information	Proced	New Procedures

These are broken down into their component parts in Appendix D, eg those who did not understand the airspace arrangement and those who were confused by the airspace arrangement.

Table 12



Key:		
	VFR	VFR pilot determined to have initiated the occurrence
	IFR	IFR pilot determined to have initiated the occurrence

Insert 4 B/923/8127 Mildura, VIC 25 March 1992

A Metroliner was on a step descent inbound to Mildura. The Metroliner attempted to co-ordinate separation with a Cessna 310, which was departing Wentworth for Balranald transiting the Mildura MTAF. The pilot of the Metroliner asked the Cessna 310 to maintain 1000feet AGL whilst his aircraft descended to 2200 feet (QNH). The pilot of the Cessna 310 affirmed his intentions to comply. Subsequent communication located the Metroliner at 4 DME crossing the 300 radial and the Cessna 310 at 7 DME on the 300 radial. Both aircraft were at 3500 feet. The pilots did not sight the other aircraft involved.

When the primary factor attributed to each occurrence was considered, the lack of traffic information and movement reports were most frequently identified (N=11 and N=9 respectively) (see Table 13).

Table 13

FACTORS ATTRIBUTED TO OCCURRENCES IN MTAFS

COMMUNICATIONS	No taxi call: Heard/Made	2
	No inbound call: Heard/Made	2
	Problems/interference	5
	Other	1
MOVEMENT REPORTING	Not given	9
	Inappropriate	2
	Confusing	2
FREQUENCY - MTAF[3]	Not published	1
TRAFFIC INFORMATION	Not available	3
	Not given	11
	Late notification	1
	Inappropriate	1
	Incorrect	1
	Confusing	1
	Other	1
NEW PROCEDURES	Not known	1

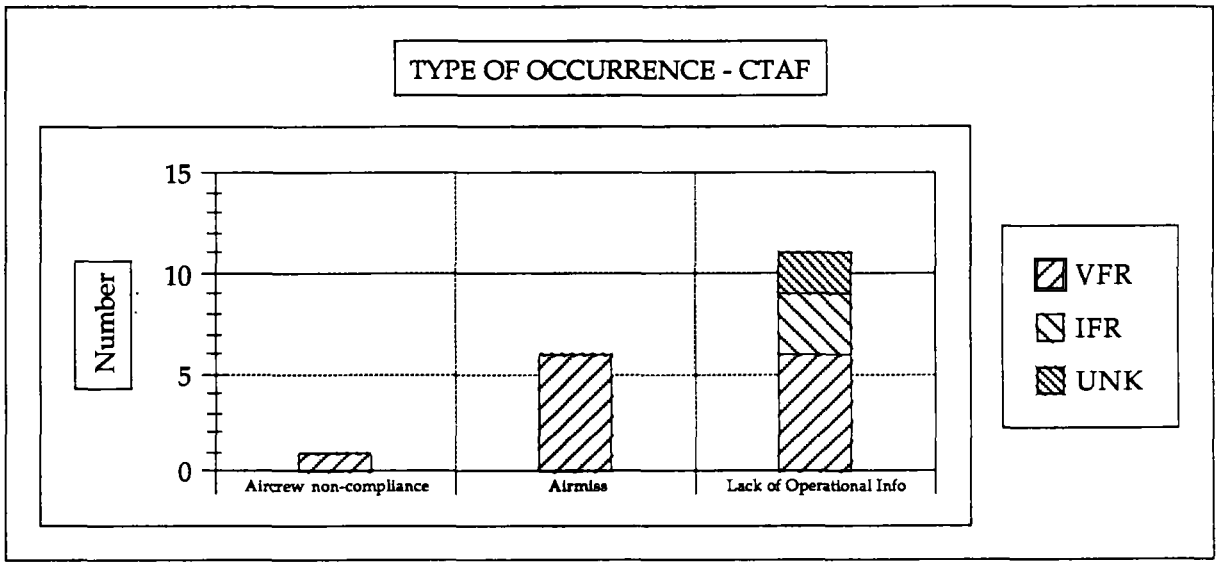
Note: In two cases no factor was determined.

3 The reporter did not receive his copy of ERSA prior to 12th of December.

3.1.3.2 CTAFs

As with the MTAFs, lack of operational information incidents were the predominant occurrence within CTAFs (see Table 14). Insert 5 provides an example of an incident in which lack of information led to an airmiss within a CTAF. The lack of traffic information was deemed to be at the core of the majority of the occurrences (see Table 15). When the locations of incidents were reviewed no one CTAF was found to be particularly prone to safety occurrences (A full listing is given in Appendix F).

Table 14



Note: In two cases the category of aircraft was not determined, ie was UNKNOWN

Key: VFR VFR pilot determined to have initiated the occurrence
IFR IFR pilot determined to have initiated the occurrence

Insert 5 B/916/8119 Aeropelican, NSW 14 January 1992

A DHC6 departed Aeropelican and made the appropriate call on CTAF frequency. The crew noticed a PA 28 on a converging course and were forced to take avoiding action. The aircraft were at 700 feet and in the judgement of the DHC6 crew the PA28 took no avoiding action. At no time did the PA28 make any radio calls except to say "good morning Pelican" immediately after the near miss. The weather was marginal VMC and as known IFR traffic was passed to the DHC6 crew it was assumed that the PA28 was VFR.

Table 15

FACTORS ATTRIBUTED TO OCCURRENCES IN CTAFS

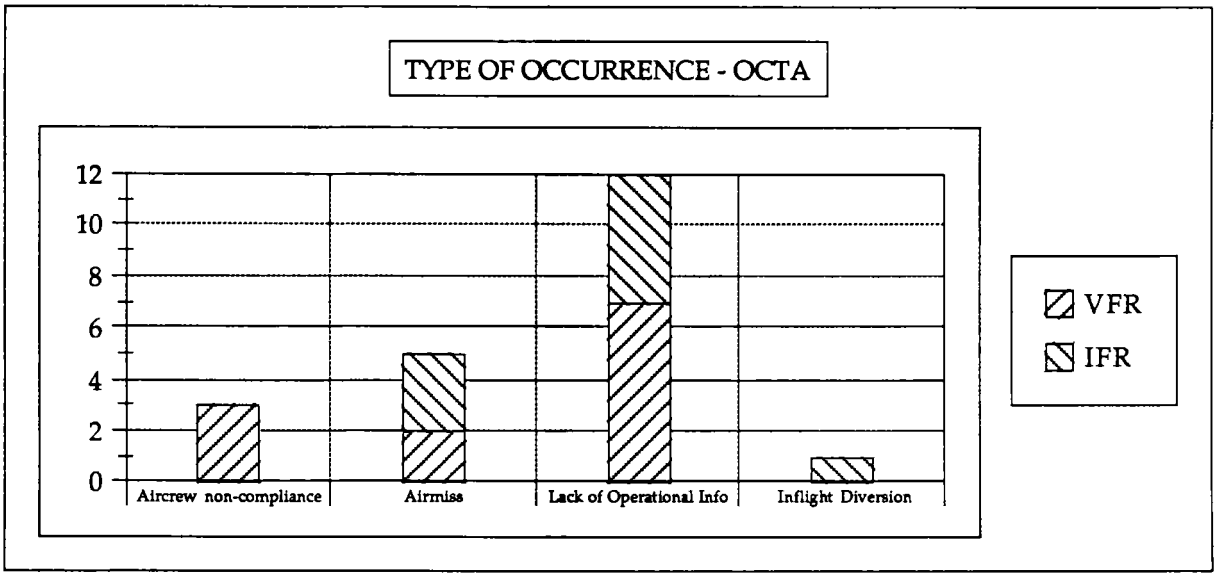
COMMUNICATIONS	No taxi call: Heard/Made	1
	Problems/interference	1
MOVEMENT REPORTING	Not given	2
TRAFFIC INFORMATION	Not given	10

Note: In four cases a factor was not determined.

3.1.3.3 OCTA

In the majority of cases, incidents which occurred outside controlled airspace (N=21) were classified as a lack of operational information (N=12) (see Table 16, Insert 6 and Appendix B). Appendix F presents a breakdown of incidents OCTA as a function of location. Many factors were found to contribute to the development of occurrences OCTA, however the majority of factors related to traffic information and movement reporting (see Table 17).

Table 16



Key:

Aircrew non-compliance	Aircrew failed to comply with approved procedures
Airmiss	Airmiss OCTA (see footnote 2 page 9)
Lack of Operational Info	Lack of operational information (see footnote 2 page 9)
Inflight diversion	Aircraft was forced to divert to an alternative aerodrome due to unforseen circumstances
VFR	VFR pilot determined to have initiated the occurrence
IFR	IFR pilot determined to have initiated the occurrence

Table 17

FACTORS ATTRIBUTED TO INCIDENTS WHICH OCCURRED OCTA

COMMUNICATIONS	No taxi call: Heard/Made	1
	Problems/interference	1
AIRWAYS CLEARANCE	Caused airborne delay	1
AIRSPACE ARRANGEMENT	Not Understood	1
FREQUENCY - ATS	Congested: Non-operational traffic	1
MOVEMENT REPORTING	Not given	1
	Incorrect	3
TRAFFIC INFORMATION	Expected (not forthcoming)	2
	Not given	3
	Late notification	1
	Incorrect	1

Note: In five cases a cause could not be established.

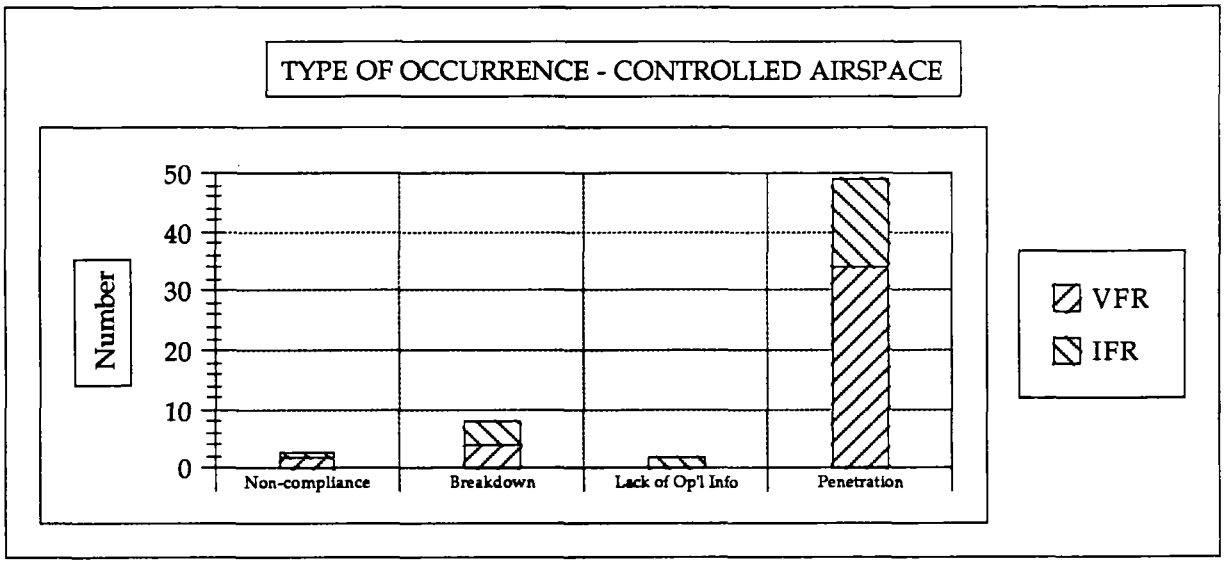
Insert 6 B/923/8123 Echuca, VIC 6 March 1992

A Cessna 404 called taxiing on CTAF, FIS and area frequencies and received no calls. The pilot then broadcast on CTAF "entering and back tracking Runway 17 Echuca" with no response and then departed making a departure call to flight service. Immediately following this an inbound PA28 contacted the Cessna 404 requesting his position. This revealed that both aircraft were five miles north of Echuca and at 3500 feet. The pilot of the C404 did not see the PA28 and commented that the pilot should have acknowledged his taxi and airborne calls. As a result, traffic passed very close at night in the opposite direction.

3.1.3.4 Controlled airspace

The majority of AMATS related incidents occurring in controlled airspace were penetrations (see Table 18), of which a large number occurred at Wagga Wagga in New South Wales (N=24) (See Appendix F). Two examples of penetrations of Wagga's airspace are given in Insert 7. In the greater number of penetrations the pilot either failed to hold outside controlled airspace until a clearance was issued or misunderstood the airspace arrangement eg location of CTA steps (see Table 19).

Table 18



Key: VFR — VFR pilot determined to have initiated the occurrence
IFR — IFR pilot determined to have initiated the occurrence.

Table 19

FACTORS ATTRIBUTED TO INCIDENTS WHICH OCCURRED IN CTA

AIRSPACE ARRANGEMENT	Not understood	12
	Confusing	2
COMMUNICATIONS	Problem/interference	1
	Other	1
AIRWAYS CLEARANCE	Holding required OCTA	15
FREQUENCY - ATS	Congested: Operational Traffic	1
MOVEMENT REPORTING	Not given	3
	Inappropriate	5
	Incorrect	2
	Confusing	1
TRAFFIC INFORMATION	Not required	1
	Not given	2
	Inappropriate	1
NEW PROCEDURES	Not known	2
	Not understood	6
	Confusing	5

Insert 7 B/926/8114 Wagga 58km ESE, NSW 3 0
January 1992

The pilot of a Cessna 172 called abeam Adelong at 6500 feet for a clearance. This position placed the aircraft 5nm within the Wagga CTA. Although no breakdown in separation occurred an IFR aircraft on climb to 7000 feet had to be held at a lower level for separation.

When the pilot of the C172 was contacted he could not accept the possibility that he had made an error, but after checking his flight plan he realised that a mistake had been made. He had misread his chart, believing that he was clear of CTA at 6500 until 25nm Wagga.

B/926/8133 Wagga 18 km N, NSW 23rd March 1992

The pilot of a Cessna 210 operating a private flight which would take him through Wagga control area (CTA) made an Area call nominating his intentions. Wagga FS replied, instructing him to call Wagga Tower at 10 nautical miles (nm) before the boundary for a clearance. The pilot decided to add a five nm buffer and call at 15 nm. Due to transmissions from other pilots he was unable to request a clearance at this point, and by the time he called for a clearance he had penetrated the CTA by five nm.

3.1.4 Improvements

Following the investigation of each incident, BASI investigators were asked to suggest how the system could be improved. In 80 cases no specific remedy was identified. In the remaining cases, the most commonly cited improvement was that of enhanced pilot education (see Table 20).

Table 20

IMPROVEMENTS REQUIRED

	Number
Documentation	2
Publication	3
Education	44
More time	3
Other (eg video)	10

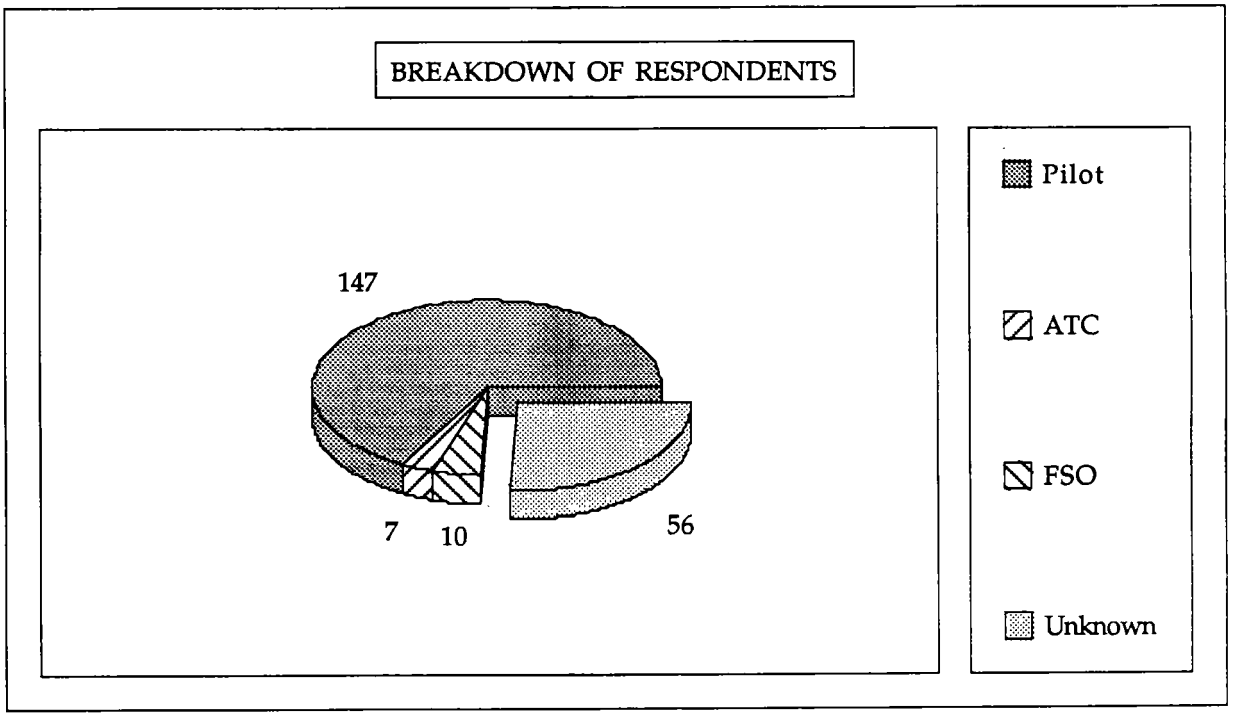
3.2 QUESTIONNAIRES AND CAIR REPORTS

3.2.1 Population

As indicated previously , 51 CAIR reports and 169 questionnaires were entered onto the project's database. Twenty-nine questionnaire respondents asked for their identity to be protected, consequently 80 actual reports were treated as CAIR reports.

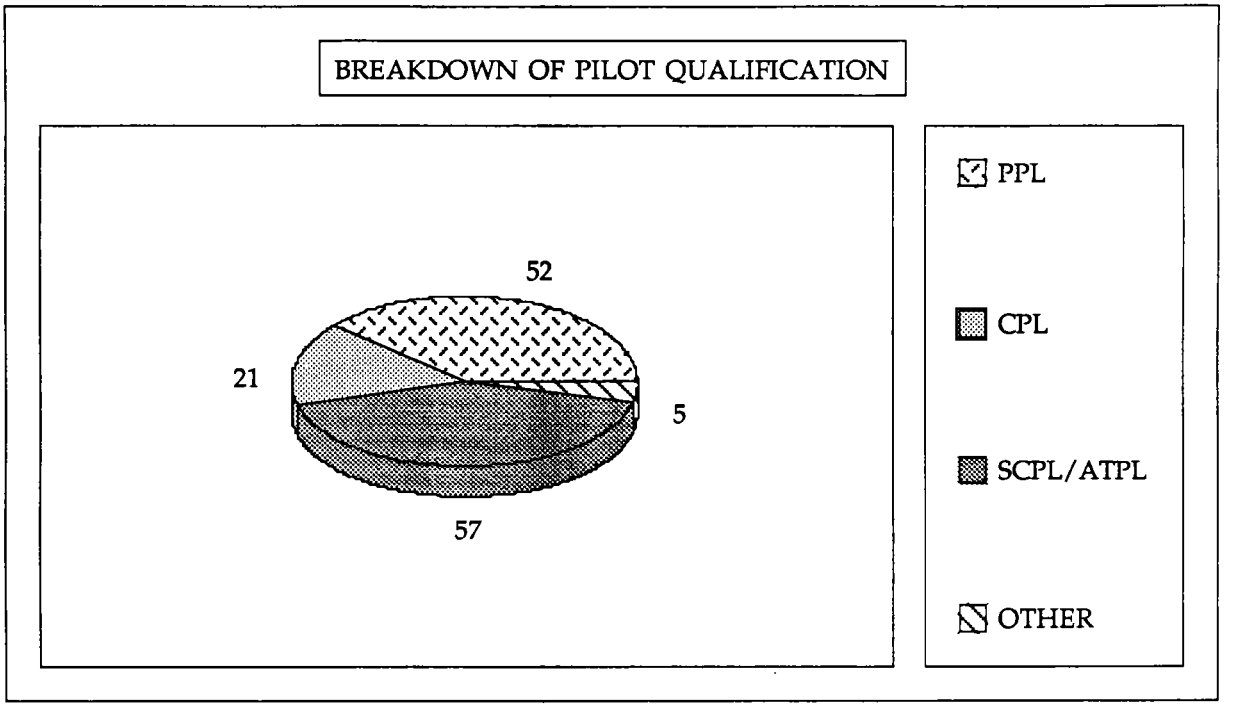
Of the 220 responses, the majority (147, 66.8%) were known to be pilots (see Table 21). Fifty-six of the respondents failed to indicate their background.

Table 21



Of the 147 pilots, 135 indicated their highest qualification. When the population was analysed according to qualification, roughly equal numbers of PPLs and SCPL/ATPLs (52 and 57 respectively) were shown to have responded to the BASI's request for information (see Table 22).

Table 22



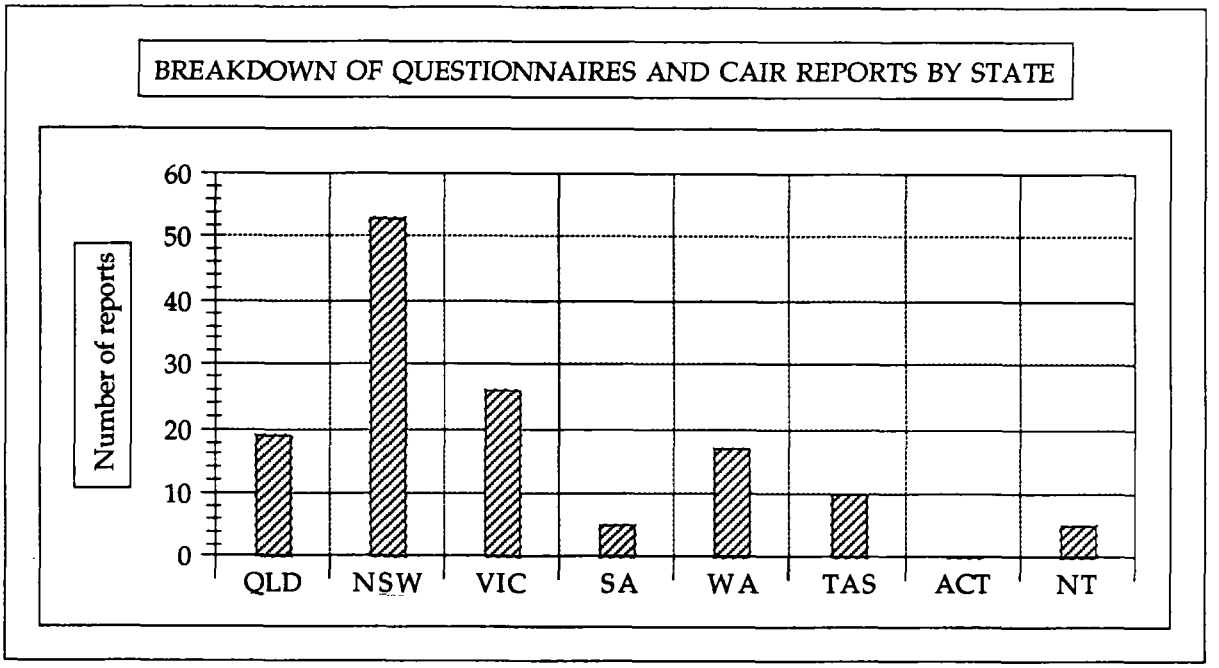
Key: PPL Private Pilot Licence CPL Commercial Pilot Licence
SCPL/ATPL Senior Commercial Pilot Licence/Air Transport Pilot Licence

3.2.2 Occurrences and Situations

3.2.2.1 Location

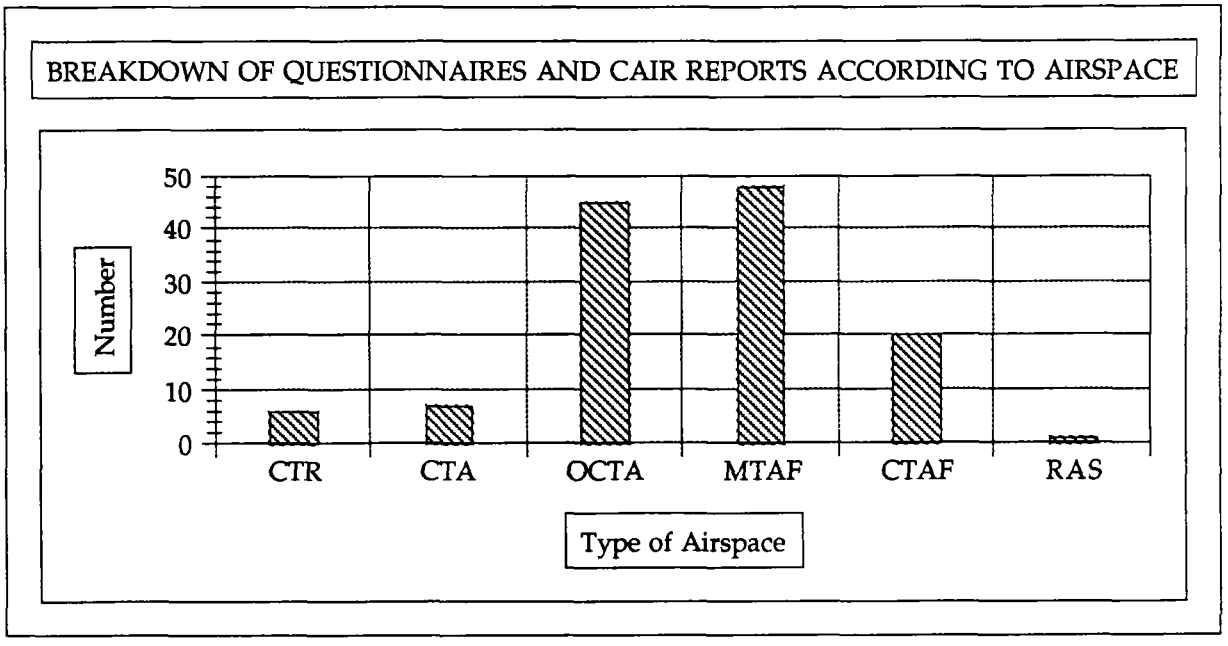
Of the CAIR and questionnaire reports held on the project database, the greatest number originated in NSW (n=52). Victoria, followed by Queensland and Western Australia accounted for the majority of the remaining reports (see Table 23).

Table 23



When the occurrences and situations reported were classified by the type of airspace, MTAFs were highly represented, as were incidents occurring OCTA (see Table 24).

Table 24



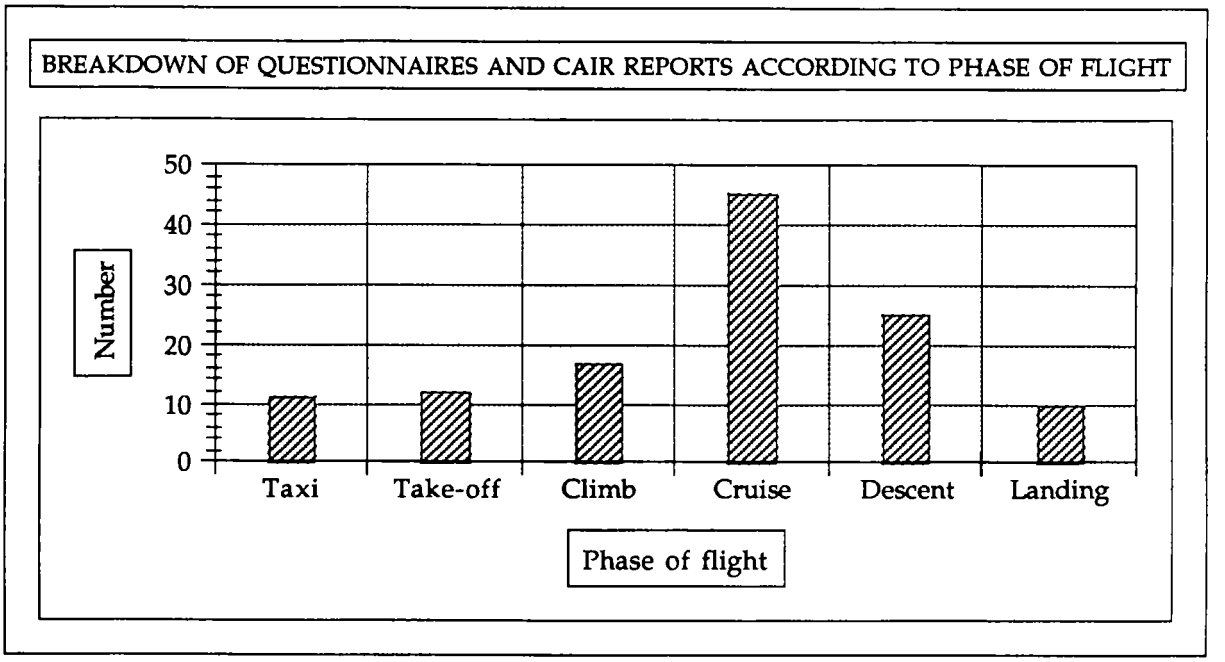
Note: 93 reports were not classified according to airspace category

Key:				
	CTA	Control area	CTR	Control zone
	RES	Restricted area	OCTA	Outside controlled airspace
	MTAF	Mandatory Traffic Advisory Frequency	CTAF	Common Traffic Advisory Frequency
			RAS	Radar Advisory Service

3.2.2.2 Phase of flight

Respondents were also asked to indicate in which phase of the flight the event under consideration occurred. The most commonly reported phase was that of cruise, with descent the second most common phase (Table 25).

Table 25



Note: 100 respondents failed to indicate the phase of flight in which the occurrence took place

3.2.2.3 Descriptions of Events

A multitude of situations and occurrences were reported to BASI through the questionnaire and CAIR system. While each event differed it was necessary to categorise into distinct groups. Due to the very nature of the reports, the descriptions cannot be categorised into equivalent groupings to those used in the investigation of incidents. Examples of the descriptions are given in Appendix G.

Table 26 indicates the majority of the problems contained within the questionnaire and CAIR reports were associated with communication between aircraft. The problem is perhaps best demonstrated in the 27 cases in which two aircraft were reported to be in close proximity yet had no knowledge of each other, or the 15 reported airmisses. In Appendix H, reported events have been sorted according to the airspace within which they occurred. The breakdown of reports from flights into MTAFs and CTAFs indicates a high percentage of reports in which an unknown aircraft was deemed to be in close proximity. Also of note were the number of problems which occurred when an aircraft was on the wrong frequency within MTAFs and CTAFs (Inserts 8 and 9 gives actual examples).

Table 26

EVENTS

	Number
Aircraft in close proximity with no knowledge of each other	27
Pilots not operating in accordance with AMATS procedures	26
Communication problems which arose because an aircraft was on the wrong frequency	23
Airmisses	15
Aircraft failure to respond to calls	14
Frequency congestion/communication difficulties	10
Difficulties associated with maintaining separation	8
Communication difficulties with ATS prior to entry into CTA	8
Communication problems for/with ATS	6
Provision of IFR traffic information service by ATS	6
Airspace design posing difficulties	4
Other	15
No report provided	58

Insert 8 Unknown aircraft in the vicinity of an MTAF or CTAF

"I taxied at Charleville for Nanacorte in my Cessna 210. I gave a taxi call on MTAF and was monitoring the area frequency. I took off on Runway 18, and at 3DME whilst still on climb to 8500', a Mooney appeared in front at the same level inbound. Since I had been monitoring both MTAF and area frequencies, and heard no inbound call,I was unaware of the possible conflict.

Subsequent discussions with the pilot of the Mooney indicated that he was monitoring both frequencies and must have given his inbound call at the same time as my taxi call and thus neither heard the other".

Note: respondent did not indicate the Mooney's level at the time of the incident.

Insert 9 Aircraft reporting on wrong frequency

"Taxiing out for circuit training we saw an aircraft overhead joining the circuit. We broadcast our taxi call, but received no answer from the other aircraft. I changed from 134.0 to 124.2 to try and raise him but with no success. I then turned the radio to 134 and had still to change the decimal radio knob, so then the radio was tuned to 134.2. I then heard the aircraft on this frequency. There was no danger as we were clear of the runway, however it highlights the problem if a pilot fails to obtain NOTAMS for the correct MTAF frequency."

3.2.2.4 Factors contributing to the Situation/Occurrence

The most frequently cited issues which were raised by pilots and air traffic

controllers in their reports can shown in Table 27. Pilots' lack of knowledge of how to operate in the system was the most frequent factor, followed by the inability to contact another aircraft and the actual design of the system.

Table 27

FACTORS CONTRIBUTING TO THE SITUATION/OCCURRENCE

Insufficient knowledge of system	20
Inability to contact another aircraft	19
Design of system	19
Lack of VFR position reports	17
ATS practices/procedures	14
Frequency congestion/over transmitting	10
Deficiencies in documentation	8
Failure of pilot to follow AMATS procedures	7
Inability of VFR pilots to resolve traffic conflicts	6
Pilot procedures/poor airmanship	5
Other	18

Note: 69 reports contained no answer.

3.2.2.5 Solutions

Respondents were asked to pose solutions to the situation or occurrence which they had described. One hundred and two respondents offered solutions. Table 28 indicates the majority of comments relate to a requirement for improved education and documentation.

Table 28

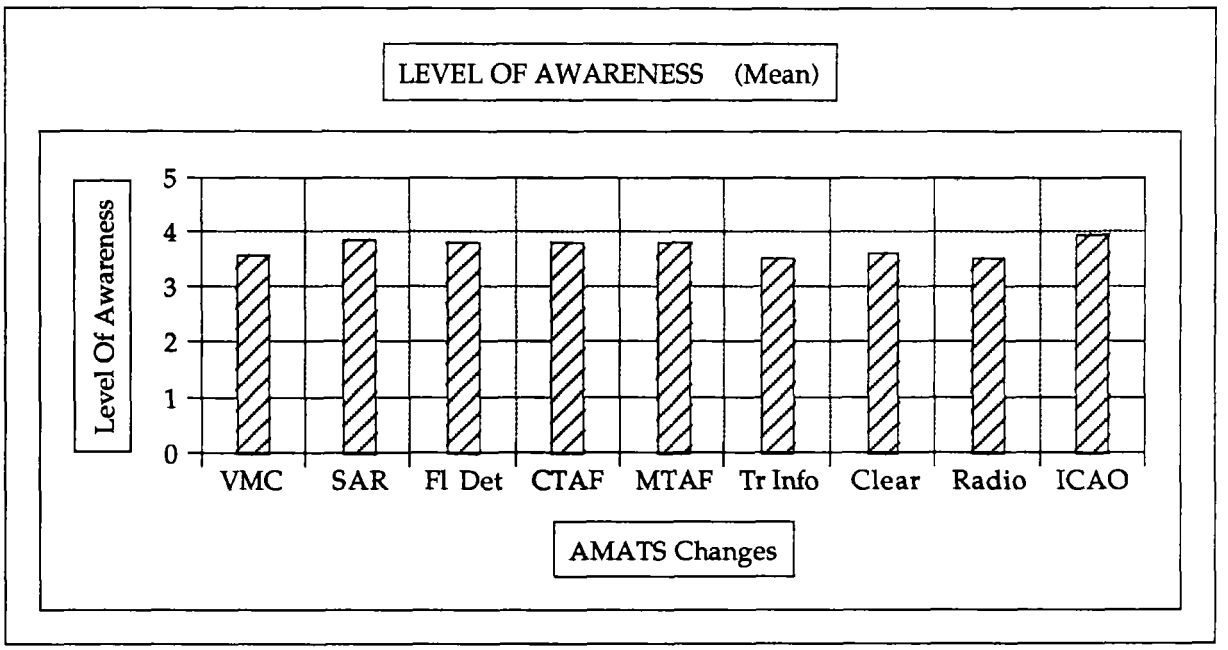
SOLUTIONS TO AMATS RELATED SITUATIONS

Education	40
Improved documentation	20
Modify ATS procedures	14
Amend requirements	13
Modify traffic reporting requirements	12
Modify pilot procedures	2
Abolish CTAFs and MTAFs	1

3.2.3 Awareness

Individuals responding to the questionnaire were asked to rate their awareness of the AMATS changes (see Table 29). A rating scale of 1 to 5 was utilised for this purpose with zero indicating no awareness and five a high degree of awareness of the changes. The mean rating across the whole sample was 3.7. Appendix I shows the results when the sample is broken into pilot and ATC groupings.

Table 29

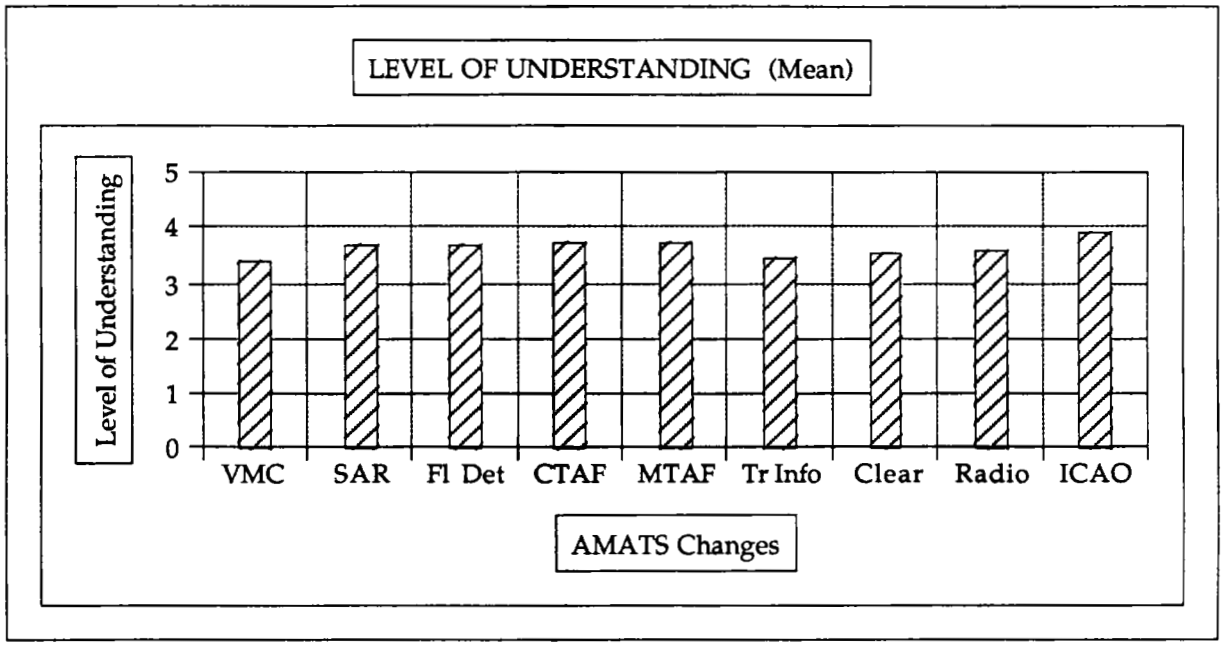


Key:
- VMC New VMC Minima
- SAR Full SAR no longer an applicable procedure for VFR flight
- Fl Det No requirement for VFR aircraft to lodge flight details with CAA unless intending to operate in CTA above 10,000 ft
- CTAF Establishment of Common Traffic Advisory Frequencies
- MTAF Establishment of Mandatory Traffic Advisory Frequencies
- Tr Info Traffic Information provided OCTA to and about conflicting IFR or Military Low Jet aircraft
- Clear Clearance to operate in controlled airspace direct from ATC
- Radio Hand-held radio use OCTA below 5000 ft by pilots of aircraft whose aircraft would not previously require the carriage and use of radio
- ICAO ICAO cruising altitudes

3.2.4 Understanding

Table 30 indicates the average rating of understanding across all respondents for each of the nine changes which were introduced on the 12th December 1991. The mean level of understanding across all the changes was found to be 3.6, when five was a high level of understanding. Appendix I shows the results when sample is broken into pilot and ATS groupings.

Table 30



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- Radio Hand-held radio use OCTA below 5000 ft by pilots of aircraft whose aircraft would not previously require the carriage and use of radio
- ICAO ICAO cruising altitudes

3.2.5 Safety

Respondents were also asked to rate the impact of each of the AMATS changes on safety using a 5 point scale. For ease of presentation zero is presented as no impact on safety, with data points between zero and -2 indicating a negative effect and zero and 2 reflecting a positive assessment on safety. Table 31 indicates the assessments and shows that the majority of the changes were believed to have a positive affect on safety. However changes associated with SAR provisions such as the removal of full reporting for VFR flights, decreased VMC minima and lack of VFR flight details were viewed in a negative light. When the results from the PPL and CPL/ATPLs are considered in isolation it is apparent that the more highly qualified pilots view the changes as having a much more negative impact on safety, particularly in regard to modifications to flight details, SAR provisions and VMC criteria. Additionally while the CPLs and ATPLs believe that the establishment of CTAFs and MTAFs would decrease safety standards,

PPLs believe would increase safety (see Table 32).

Table 31

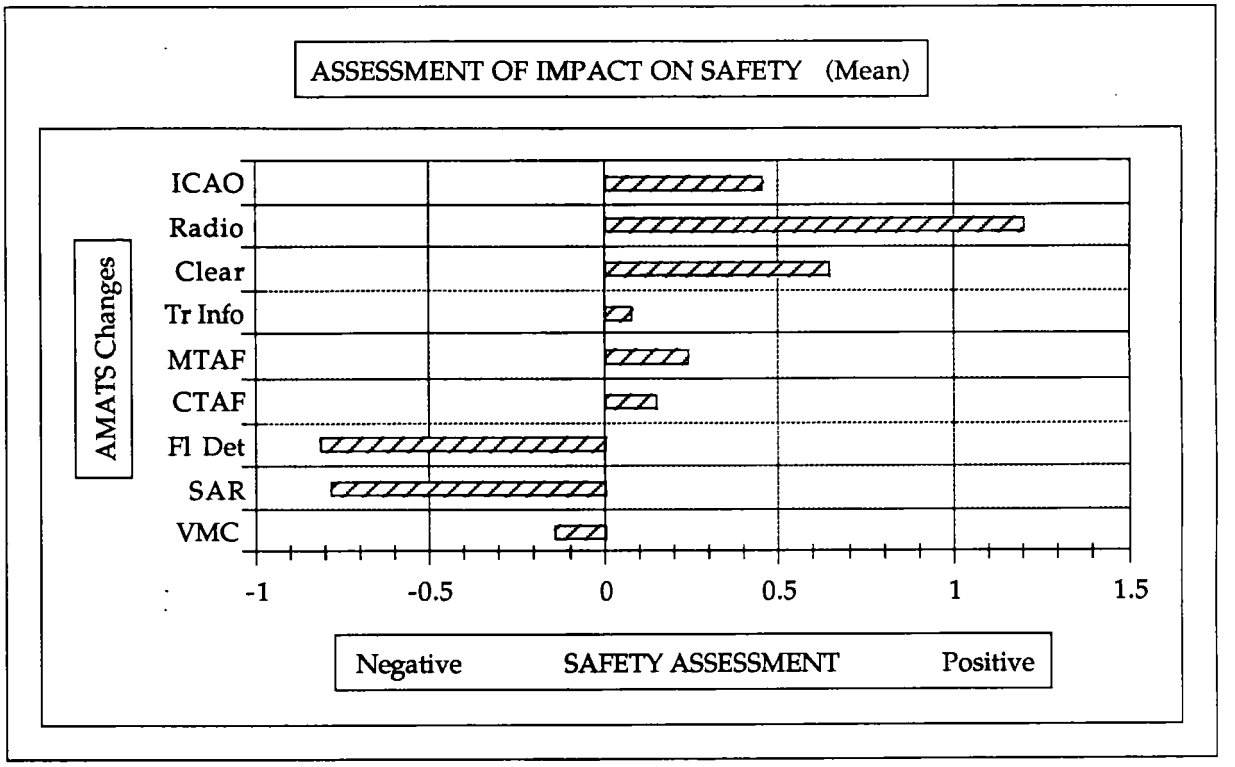

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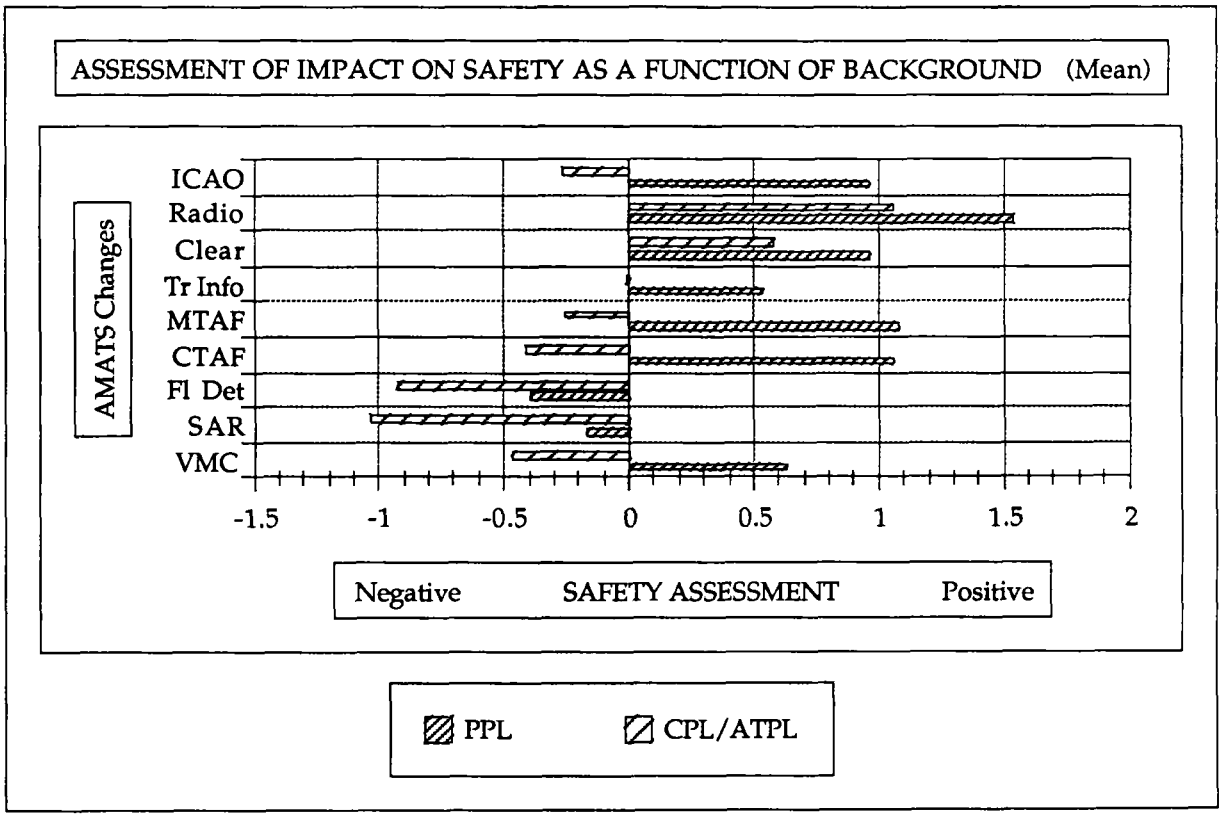
Table 32



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Appendix J provides details of pilot and ATS response to this item.

3.2.6 Education

The CAA mounted a vigorous education campaign prior to the introduction of AMATS. Respondents to the questionnaire were asked to indicate which aspects of the education process they had been exposed to and also rate the effectiveness of each aspect. The results indicate that respondents rated the printed material published by the CAA as being most effective, information which was the most readily available (see Table 32).

Table 32

ACCESS TO INFORMATION AND AVERAGE RATING OF EFFECTIVENESS

	Number	Average Rating (Max. 4)
Printed Material	134	3.2
Seminar	76	2.8
Video	90	2.2

Note: Of the 134 respondents who rated the effectiveness of printed material, 16 based their rating on AIC 35/91, 45 on Airspace, and 38 rated all material posted from the CAA (see Appendix K for breakdown according to publication type).

Chapter 4

Analysis of the Results

4.1 THE SAMPLE

During the period of data collection, 147 incidents were reported to the Bureau and 220 reports were received through the questionnaire and CAIR system.

4.1.1 Investigation Data

It is recognised by BASI that the number of reported incidents may not be all the air safety occurrences in which the AMATS changes were implicated in the period under review. Views presented to BASI investigators were that as AMATS was a *"fait accompli"* and there was little point in reporting situations in which safety standards were breached. BASI is equally cognisant of the fact that reporting patterns may have been modified simply through BASI's advertised interest in the impact of the AMATS changes. The high number of reported penetrations at Wagga in NSW may reflect this affect.

The incidents reported in the data collection period must be viewed as being a representative sample of those which did occur.

4.1.2 Questionnaires and CAIR reports

The questionnaire asked respondents for their assessments of the changes and situations which arose following the introduction of AMATS. The CAIR system, while not soliciting information, did provide an avenue through which safety concerns could be raised. BASI is unaware of just how representative such responses were of the aviation community as a whole. Obviously those who had serious concerns about the safety of AMATS were more likely to respond. However, the relative weight given to safety concerns by respondents is still indicative of which areas may need attention. Furthermore the fact that only a minority of pilots share a concern does not mean that the concern is not valid. Consequently a similar extrapolation has been made to the occurrence data, that is that questionnaire and CAIR reports provided a valid and perhaps representative insight into the functioning of the aviation system following the introduction of AMATS.

4.2 LACK OF OPERATIONAL INFORMATION

A striking feature of the data was the preponderance of incidents which were categorised as lack of operational information, ie information upon which the pilot could base operational decisions. The majority of these were attributed to the failure of pilots to respond to other aircraft movement reports or carry out the required calls.

4.2.1 Position Reporting

Relevant VFR aircraft position reporting is an integral and vital component of the new system. Comments such as its "deadly quiet" were not uncommon from both IFR and VFR pilots. It seemed that VFR pilots were failing to notify other aircraft of their actual position in response to movement calls or calls within MTAFs or CTAFs. Reasons behind the reluctance of VFR pilots to call included:

(a) failure to recognise themselves as traffic, either because the relevance of the call was misunderstood or the pilot did not appreciate the relative closing speeds of the two aircraft,
(b) unfamiliarity with reports which were being made, eg location being made in terms of a position on a radial, and
(c) a reluctance to use the radio, especially to communicate with professional pilots.

The lack of VFR position reports was of deep concern to the whole industry. For many years the aviation system provided support for the VFR pilots with traffic information, and reminders to remain OCTA. Under AMATS, the support for the VFR pilot has been removed, and the system is more reliant on the VFR pilot's compliance with published procedures.

The education campaign prior to the introduction focused on the new status of the VFR pilot and position reporting. For example:*"when you hear IFR traffic which may pose a conflict to your flight you should do the following: in good visibility, look out for the traffic and see and avoid (it needs to be stressed there is no need for you to talk to the IFR flight")* [4]. BASI recognises that a balance has to be achieved between "irrelevant chatter" and no information. However inadequate reporting results in incorrect situational awareness for all aircraft in the area. VFR pilots require additional training, confidence and familiarity with the new procedures. Confidence can be achieved over time. However IFR and VFR pilots can aid each other by providing position reports indicating physical location.

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4 Airspace 91

4.2.2 Movement Reporting

Movement reporting, like position reporting, is vital in ensuring that situational awareness is maintained. Indications are that like position reports, movement reports have been insufficient. Consequently it may be necessary to mandate calls on changing level and frequency in order to alleviate the disquiet within the aviation community and provide some structure for the VFR pilot when operating OCTA.

Dialogue between pilots is particularly necessary within the limited airspace of CTAFs and MTAFs. Numerous reports reached the Bureau of aircraft entering such airspace having made all relevant calls to find another aircraft departing on similar tracks, and vice versa. In some instances, the investigation determined that both sets of calls had been made at exactly the same time, in others that aircraft had failed to make calls, or calls had been made and the other pilot was monitoring another frequency.

In view of the above, BASI believes there is considerable merit in reinstating an airborne call, equivalent to a call on departing the MTAF or CTAF. This call would provide an increased opportunity for an aircraft's presence to be recognised by other aircraft within and in the vicinity of a CTAF or MTAF. In addition, pilots' situational awareness regarding traffic disposition can be improved by indicating the location in calls associated with CTAF or MTAF, eg "all stations Kununurra MTAF" (as indicated in AIC H9/1992).

4.3 AIRMISS

The majority of airmisses were a direct result of the aircrew's failure to follow approved procedures. The earlier links in the chain of events leading to the airmiss such as position reporting and movement reporting have previously been discussed.

4.3.1 See and Avoid

When the descriptions of the airmisses are reviewed it is apparent that the two aircrew involved seldom see each other's aircraft until there is a potential risk of collision. The pilots in question advised, that even though they were vigilant in their watch, aircraft at the same level, or at a lower level tend to blend into the background. Such information provides evidence of the limitations of unalerted see and avoid. In BASI's report on the limitations of see and avoid it was stated:

"Unalerted see-and-avoid has a limited place as a last resort means of traffic separation at low closing speeds but is not sufficiently reliant to warrant a greater role in the air traffic system. BASI considers that see-and-avoid is completely unsuitable as a primary traffic separation method for scheduled services"[5].

Effective traffic separation outside controlled airspace can only be achieved by using all facilities at the pilots' disposal. This includes using the radio effectively and being visually alert.

4.4 PENETRATIONS

The changes regarding airways clearances for entry into controlled airspace were viewed in a positive light by those who responded to the questionnaires. Yet penetrations of controlled areas, zones and restricted areas accounted for 49 of the 147 AMATS related occurrences. Of all penetrations, 85.5% related to failure of the aircrew to follow approved procedures. In most instances flight crew either failed to hold outside controlled airspace before gaining a clearance or misunderstood the airspace arrangement.

Failure to hold outside controlled airspace was attributed to:

(a) a lack of understanding of the basic principle behind the change in procedures;
(b) deliberate breaches;
(c) frequency congestion preventing calls for clearance with the pilot deciding to continue the flight into controlled airspace; or
(d) the assumption that ATS were fully aware of the pilot's intention.

It may be suggested that the introduction of ICAO cruising level has increased the potential for penetrations. The new levels have ensured that pilots who for many years may have entered controlled airspace at a particular level or step may now be approaching at a higher altitude, and enter controlled airspace earlier in their approach to a particular aerodrome. Penetrations were also attributed to pilots misinterpreting the meaning of the published upper and lower limits on AIP charts.

Airspace complexity in some locations, eg Gladstone/Rockhampton (see Insert 2) seemingly induce penetrations. The actual proximity of MTAFs to CTA boundaries, in association with ATS procedures, may result in a level of workload which makes it difficult for the pilot to call ATS for a clearance prior to entry into CTA.

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5 "Limitations of See and Avoid Principle" April 1991 BASI Research Report

A reduction in the number of penetrations may be achieved through:

(a) reinforcing the pilot's responsibility in regard to entry into controlled airspace; and
(b) enhancing the display of horizontal and vertical boundaries of CTA steps on charts.

Problems which originate with airspace complexity may be overcome by modifying ATS procedures to allow clearances to be gained when an aircraft is still on the ground, eg when within 50NM of entry to CTA.

4.5 IFR TRAFFIC REPORTING

Flight service (FS) are responsible for alerting IFR aircraft to the presence of other IFR aircraft. Such service was criticised particularly in regard to operations in MTAFs. In most instances the criticism was focused on incomplete IFR traffic information being passed when the pilot made a taxi call to FS, ie, IFR aircraft who reported as changing to the CTAF or MTAF frequency were not given as traffic to other IFR aircraft within the CTAF/MTAF.

Many IFR pilots indicated that they should be provided with all traffic information including VFR, thereby allowing them to determine potential traffic conflicts.

4.6 CHARTS AND NOTAMS

The study identified pilots giving calls on frequencies which were no longer applicable. Pilots also claimed that the large number of documents required to determine where to change frequency, increased workload. Criticism was levelled at charts which failed to provide (i) frequency boundaries, (ii) the frequency allocation for MTAFs and CTAFs, or (iii) clearly identify the lower limits of CTA/CTR. All of the above were indirectly or directly attributed to the development of incidents.

4.7 FREQUENCY CONGESTION AND INTERFERENCE

Previously the impact of lack of operational information has been discussed. However, instances were also identified in which frequency congestion and interference led to reductions in safety standards. In some situations, situational awareness was degraded by the quantity of traffic on frequency. Some of the traffic was at a considerable distance from the aircraft in question. For example cross interference resulted in aircraft in Victorian CTAF/MTAF often being heard on the same frequency as in CTAFs and MTAFs in Tasmania.

While cross interference was the main basis of complaints regarding frequency congestion, other problems were raised such as the congestion which results from military exercises. "Kangaroo 92" totally congested the frequencies to all

civilian operations.

Only two instances were reported in which pilots making "irrelevant" calls disrupted the flow of operational information. However pilots did criticise what was termed the excessive use of the FIS VHF retransmission facilities. Resectorisation of FS sectors along with modified operating philosophies should reduce the need for FSOs to use the retransmit facility.

Maintenance of situational awareness is vital in a system which is almost totally reliant on a VFR pilot's ability to determine traffic conflicts. The CAA has a difficult task in ensuring that while the number of frequencies are minimised to reduce workload and the potential for pilot error, these frequencies are not cluttered by cross interference or retransmissions.

4.8 RADIOS AND RADIO PROCEDURES

The introduction of AMATS ensured that aircraft such as ultralights had to carry radios. In at least one occurrence the fact that an ultralight was operating in a CTAF without a radio led to an airmiss. Additionally the quality of calls from ultralights and the ability of their pilots to hear the other aircraft's transmission also came in for criticism.

The quality of calls from pilots was also questioned by some reporters. In some cases this reduction may directly relate to pilots not wishing to be charged for landing at aerodromes, while in others non standard calls may also reflect the perceived withdrawal of the CAA from the system.

4.9 UNICOM OPERATORS

As indicated in the CAA's report on the "Review of MTAF and CTAF in Australia", the questionnaire published in the BASI Journal elicited information regarding Unicom operations. In one instance the Unicom operator was quoting a "duty runway" when in fact there was considerable cross wind. In "controlling" the field rather than providing accurate information, Unicom operators are *over* exceeding their authority and responsibilities.

BASI concurs with the conclusions made in the above review that the Unicom operators are lacking in experience and require some training from the CAA regarding their role.

4.10 CAPACITY OF CTAFS AND MTAFS

While not being directly relevant to the study, BASI does have some concerns that the CAA has done little to determine the traffic capacity and mix of aircraft operators into CTAFs and MTAFs. The size of the airspace must limit the

number of aircraft which can operate safely within it. The Bureau therefore suggests that the CAA reviews the traffic concentration at various locations and determines what traffic density constitutes a hazard to safe flight.

4.11 EDUCATION

The high level of reported awareness and understanding in the questionnaire data may reflect the effectiveness of the CAA education campaign prior to the introduction of AMATS. Despite the inaccuracies within the text, the high ratings achieved by "Airspace 91", indicates the effectiveness of a publication which is written in plain English and emphasises examples of how the system should work.

In spite of the reported high levels of understanding, the questionnaires and incidents illustrate basic errors which reflect poor understanding and awareness, eg, pilots entering CTA without a clearance. Numerous reports demonstrate that while pilots may understand the principles behind the changes they are unable to actually put the principles into practice. This inability is perhaps best illustrated by those occurrences where IFR aircraft came into close proximity with VFR aircraft even though the IFR aircraft had made appropriate calls. These occurrences may demonstrate that many VFR pilots are ill prepared to determine whether other aircraft constitute "traffic" or to resolve three dimensional traffic conflict situations.

VFR pilots should be able to operate in the AMATS system as easily as pilots do in the well publicised system in the United States, which has a degree of similiarity to that adopted by Australia. However, the pilots within the US were trained within their system while the majoirty of the Australian pilots were trained prior to the introduction of AMATS. To overcome this, remedial training could be introduced for pilots. Additionally, PPL training could incorporate how to determine whether an aircraft constitutes a conflict. This could be demonstrated during training involving operations in CTAFs and MTAFs.

Information available to pilots since the introduction of AMATS has been limited to articles in the BASI Journal and the CAA's Aviation Bulletin, and AIC H9/92. These articles have highlighted both the success and the problems associated with the introduction of AMATS. The problems have as yet not been addressed in educational literature. There is general concensus within the aviation industry and organisations such as BASI that safety standards can be assured through an ongoing educational process.

4.12 THE PROCESS OF CHANGE

Prior to the 12th of December there was considerable apprehension among many pilots regarding the impact of the AMATS changes on operating procedures and safety standards. While the changes have certainly had an impact on safety, it

has not been as dramatic as many critics expected. It may be that the introduction of AMATS was aided by the low levels of aviation activity, particularly in GA. If this is the case, the true impact of AMATS may not have yet been revealed.

At the present time pilots are gaining confidence in the new system and in their ability to operate effectively under AMATS. It should be recognised that this confidence will take a considerable time to amass, and caution is required before further changes are introduced.

It should also be recognised that not all pilots have operated in the first phase of AMATS and may well resume flying during the later phases.

4.13 SAFETY NET

The safety of any complex system is based on each component part working effectively and to the standard expected by the designers. In most instances controls, procedures and technological devices are built in to ensure that errors are caught before they degrade safety standards. This protection is usually termed the safety net. Under AMATS, the safety net includes procedures which dictate standard cruising altitudes, calls for alerting traffic to the presence of other aircraft and procedures to be adopted prior to entry into controlled airspace. Non-compliance with these procedures can significantly erode safety standards. Compliance can be aided through education, procedures and airspace design.

4.14 SAFETY STANDARDS

VFR pilots see AMATS as increasing safety standards, seemingly equating safety with the ease of flying. In comparison, IFR and professional pilots stated that safety had been reduced to the "lowest common denominator". The concerns expressed by IFR pilots have previously been considered, eg lack of position reports, inability of VFR pilots to prevent traffic conflict situations. The statistics do indicate that the VFR pilot is most often in error in AMATS related occurrences. Additionally a considerable number of fare paying passengers have been put at risk. The period under review may be viewed as the bottom of the "learning curve", and this is reflected in the reduction in the number of incidents in March and April.

4.15 DISSEMINATION OF INFORMATION

Areas of particular concern to BASI were brought to the attention of the CAA throughout the data collection and analysis period. BASI provided input into CAA publications, such as AIC H9/92, a document which promoted practices which were believed to enhance safety standards.

Articles in the BASI Journal also addressed issues such as position reporting, the need to use the radio effectively and the problems which were associated with

penetrations of controlled airspace. This feedback loop was considered to be an effective way of promoting good practice within the pilot community.

Chapter 5

Conclusions

In the four month data collection period following the introduction of AMATS, 147 occurrences were reported to the Bureau which were deemed to be related to the airspace changes. In addition to occurrence reports, BASI also gleaned information from deidentified CAIR reports and a specially designed questionnaire. Fifty-one CAIR reports and 169 questionnaires were available for this purpose.

The results indicated that 34% (70) of those aircraft involved in occurrences were operating privately, while 17% (34) aircraft were operating RPT services. Ninety four of all aircraft were operating under VFR and 46 under IFR procedures. Of those aircraft which initiated the occurrence, 65 were operating privately, 29 were in aerial work and 20 in regular public transport operations.

The most frequent type of occurrence was that categorised as "lack of operational information", eg an aircraft not providing a position report following a broadcast from another aircraft on a potentially conflicting track. This type of occurrence was closely followed in frequency by penetrations of controlled airspace and airmisses. Regardless of the type of occurrence the majority were attributed to pilot aircrew's failure to follow approved procedures. The questionnaire and CAIR data reflected the findings of the occurrence data.

Within MTAFs, CTAFs and OCTA, failure to follow approved procedures was attributed to the failure of the pilot to respond to other aircraft movement reports or to carrying out required calls. In the majority of cases, the pilot in question was operating under visual flight rules. Reasons behind the reluctance of VFR pilots to call were believed to be associated with conflict recognition, unfamiliarity with the reports provided by other aircrew and a reluctance to use the radio.

When penetrations of controlled airspace were considered, in the majority of cases the aircrew simply entered CTA without requesting a clearance from ATC. Failure to hold outside controlled airspace was attributed to either a lack of understanding of the basic principle behind the change in procedures, deliberate breaches, frequency congestion or the assumption that ATS were fully aware of the crews' intentions.

While pilots reported a high level of awareness and understanding of the AMATS changes the scenarios revealed within the questionnaires and incidents illustrated a series of basic errors. These errors may reflect the inability of pilots to put the principles associated with the AMATS changes into practice, for example being unable to resolve three dimensional traffic conflicts.

The CAA's education campaign focused on the status of the VFR pilot. There was a general concensus amongst the pilot community that the VFR pilot had been told to keep quiet. This tenet resulted in a reluctance to use the radio and this led on occasions to a lack of traffic awareness for both VFR and IFR aircraft.

In summary, the introduction of AMATS placed more responsibility on the component of the system with the least skills and training, ie the VFR pilot. The safety of the aviation system under AMATS can only be achieved if all pilots and ATS personnel comply with the standards and procedures. Even a small number who fail to comply can have a detrimental effect on safety. This is particularly relevant as the safety net is limited to procedures alone. As such it is necessary to refine the system to ensure that it is tolerant to the errors of pilots and ATS personnel. This error tolerance can be achieved through education, procedures, documentation and airspace design which aim to increase pilot compliance and reduce workload.

No recommendations are associated with this report. Issues of immediate concern were brought to the attention of the CAA during the report's completion. The CAA addressed a number of these issues in publications such as AIC H9/92. Articles in the BASI Journal provided feedback to the aviation community regarding good practice whilst operating in the AMATS environment. Other issues which would have warranted a recommendation to the CAA have already been addressed in the Bureau's report on violations of controlled airspace.

REFERENCES

Bureau of Air Safety Investigation "Limitations of See and Avoid Principle" April 1991

Bureau of Air Safety Investigation "BASI Journal 10" December 1991

Bureau of Air Safety Investigation "BASI Journal 11" March 1992

Bureau of Air Safety Investigation "BASI Journal 12" June 1992

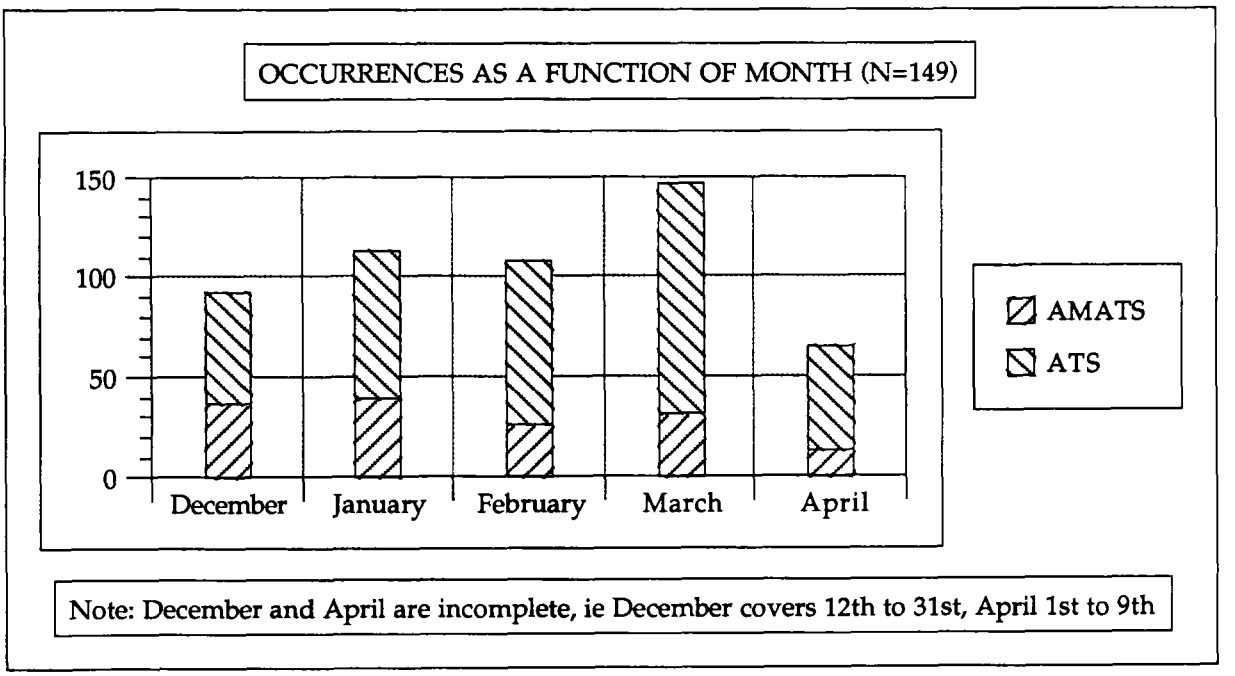
Civil Aviation Authority "Airspace 91" November 1991

Civil Aviation Authority "AIC H9/1992"

Civil Aviation Authority "Report on the Review of MTAF and CTAF in Australia" June 1992

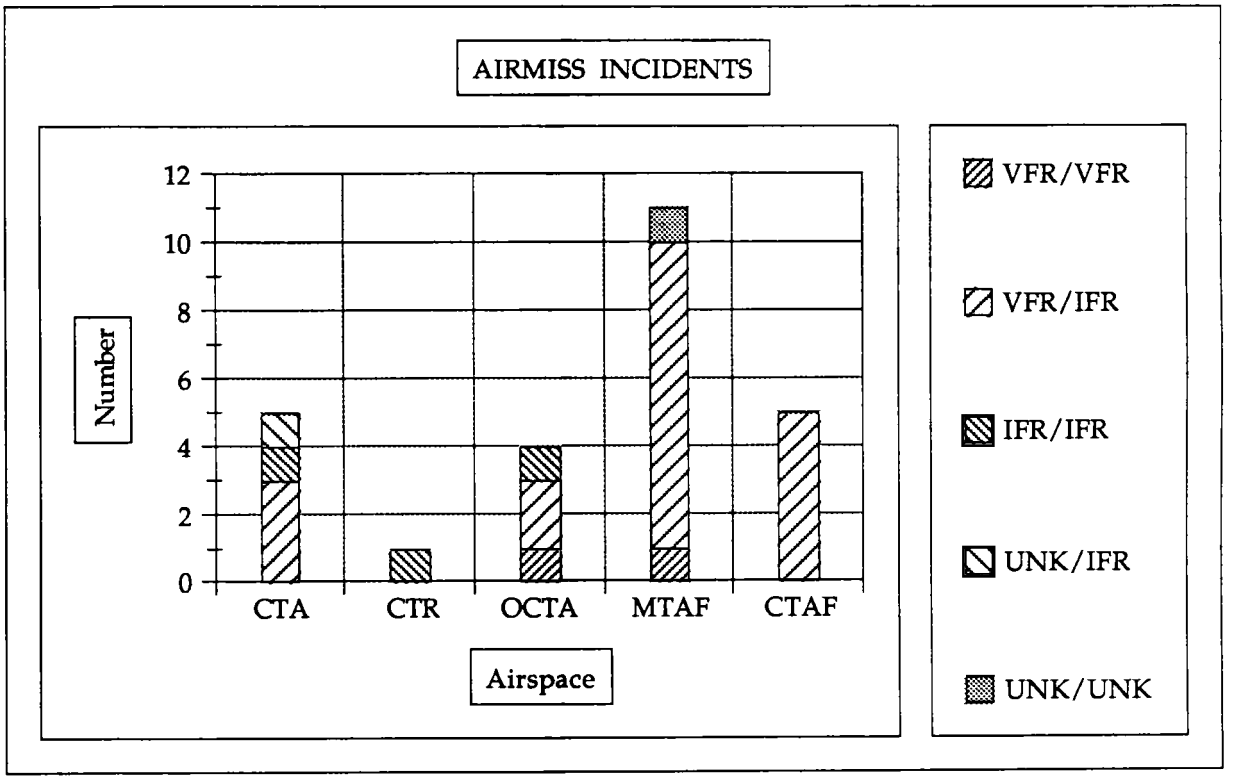
Civil Aviation Authority "Finalisation Actions Associated with the Report on the Review of MTAF and CTAF in Australia" October 1992

APPENDIX A

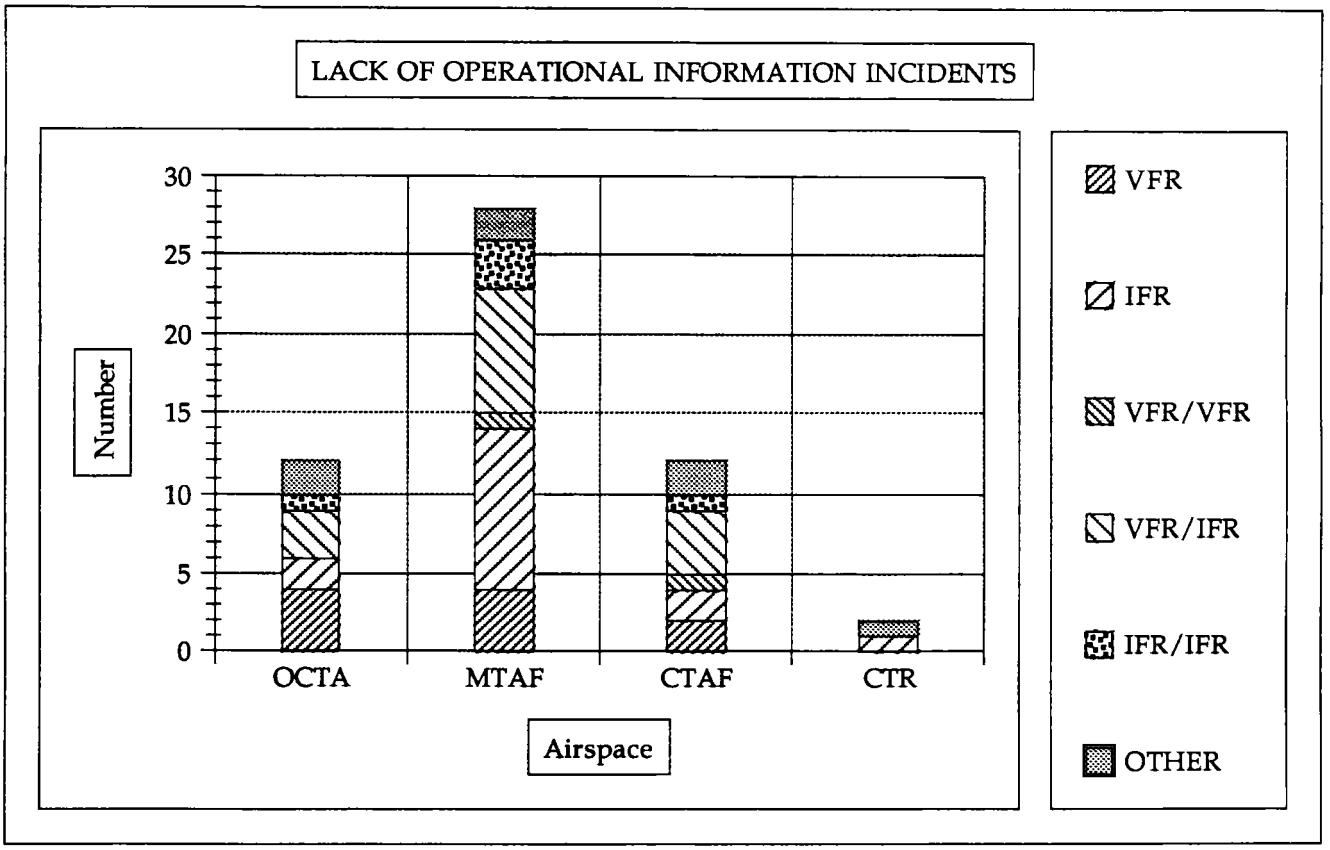

OCCURRENCES AS A FUNCTION OF MONTH (N=149)
150
100
50
0
December
January
February
March
April
AMATS
ATS
Note: December and April are incomplete, ie December covers 12th to 31st, April 1st to 9th

APPENDIX B

(i) Airmiss Incidents



(ii) Lack of Operational Information Incidents



APPENDIX C

BASI CRITERIA OF COLLISION RISK

AIRMISS REPORTING

Critical Risk *Category A*

Any incident which involved a high risk of collision with the aricraft passing within 100 feet vertically and 500 feet horizontally.

Potential Risk *Category B*

Any incident which could have resulted in a critical risk of collision if no action had been taken by either the aircrew or Air Traffic Services. The closest proximity was greater than 100 feet vertically or 500 feet horizontally.

or

An incident where no avoiding action was taken and the direction, altitude and horizontal separation were such that there was a risk of collision.

No risk *Category C*

An incident involving a breakdown of prescribed separation standards where direction, altitude and horizontal separation were such that there was no probability of a collision.

APPENDIX D

ATTRIBUTED FACTORS

	Number
Airspace Arrangement	17
Communications	41
Airways Clearance	44
Frequency	3
Movement Reporting	47
Frequency - Non ATS	3
Radar	1
Traffic Information	46
New Procedures	27

BREAKDOWN OF ATTRIBUTED FACTORS

			Number
Airspace Arrangement	Not Understood		15
	Confusing		2
Communications	No Taxi Call	Heard/Made	7
	No Inbound Call	Heard/Made	12
	Confusing		1
	Interference		15
	Other		6
Airways Clearance	Caused Airborne Delay		1
	Required Holding		43
Frequency - ATS	Congested: Operational Traffic		2
	Congested: Non-operational Traffic		1
AMATS Introduction	Satisfactory		1
	Inadequate Explanation		1
	Too complex		1
	Not understood		1
	Insufficient Notice		1
Movement Reporting	Not available		1
	Not given		24
	Inappropriate		18
	Incorrect		3
	Other		1

Frequency - Non ATS	Not published	1
	Not known	1
	Congested	1
Radar	Not available	1
Traffic Information	Not available	3
	Not required	1
	Expected	2
	Not given	29
	Late notification	2
	Inappropriate	4
	Incorrect	2
	Confusing	1
	Other	2
New Procedures	Not known	3
	Not understood	14
	Confusing	10

APPENDIX E

The incident illustrated occurred in Victor 1. Although it is not technically a MTAF, the relevant MTAF procedures are adopted and for this reason it has been included in section 3.1.3.1.

B/921/8108 R409C and Route Victor 1, NSW 20th January 1992

This incident investigation was based on reports that airmisses were occurring on a daily basis in Victor 1. This complaint revolved around the number of aircraft that were using V1 and were not reporting their positions at all or with insufficient accuracy. The report considered that many pilots were not listening out. It was reported that the cliffs made it very hard to sight traffic, as aircraft tended to merge with the background and on one occasion a Citation went through unannounced and at high speed.

APPENDIX F

LOCATIONS OF INCIDENTS

MTAF

Location	Number of incidents
Gove	1
Tindal	1
Albury (after hours)	1
Kalgoorlie	4
Kununurra	3
Learmonth	1
Dubbo	2
Bundaberg	5
Carnarvon	1
Cooma	2
Gladstone	1
King Island	6
Newman	1
Mildura	10
Port Macquarie	1
Wynyard	6
Yulara	1

CTAF

Location	Number of incidents
Armidale	1
Echuca	2
Flinders Island	1
Geraldton	1
Horsham	1
Maryborough	1
Aeropelican	2
Quilpie	1
Renmark	2
Roma	1
Rottnest	2
Young	1
Newman	

CTA

Location	Number of incidents
Alice Springs	2
Brisbane	1
Maroochydore	1
Oakey	1
Rockhampton	1
Albury	1
Hobart	1
Melbourne	3
Perth	1
Katoomba	1
Canberra	2
Sydney	6
Tamworth	1
Wagga Wagga	24
Orange	1
Katoomba	1

CTR

Location	Number of incidents
Darwin	1
Adelaide	1
Amberley	2
Parafield	1
Richmond	1
Tamworth	1
Wagga Wagga	2

Restricted Areas

Location	Number of incidents
R409 C	1
R526	1
R527	2
R548C	1

OCTA

Location	Number of incidents
Queensland	3
New South Wales	10
Victoria	4
Western Australia	3
Northern Territory	1

APPENDIX G

Below are examples of CAIR and questionnaire reports that have been printed as they were received by BASI. The only alterations which have been made have been to ensure that the respondents cannot be identified.

Communication problems which arose because an aircraft was on the wrong frequency

"On arrival at ASWM the crew saw a Cessna type aircraft in the circuit at approximately 1500-2000 feet. We tried to contact the aircraft on MTAF with no response. We then tried on FIS and the aircraft responded that he was overflying ASWM for Maitland" *Questionnaire response*

"Taxiing for circuit training we saw an aircraft overhead joining the circuit. We broadcast a taxi call, but there was no answer from other aircraft. I changed from 134.0 to 124.2 to try and raise him - no answer. Turned back radio to 134.0 and still to change decimal radio knob. I heard the aircraft on this frequency." *CAIR response.*

Aircraft failure to respond to calls

"Turning final on Runway 12 at Kununurra we observed a C172 climbing out after takeoff from runway 30. The aircraft turned crosswind as normal giving no indication of observing our aircraft. We called the aircraft on the MTAF frequency asking whether he had heard our inbound or circuit calls or observed us in the circuit but received no reply" *CAIR report*

Aircraft in close proximity with no knowledge of each other

"On joining the circuit, crosswind for a landing on Runway 05 and looking down to approach the threshold, I observed an aircraft on final for landing on Runway 05. This aircraft was completely unknown to us and did not respond to our transmissions on either MTAF or FIS." *CAIR report*

"I taxiied at Charleville for Navacorte in my C210. I gave a taxi call on the MTAF and was monitoring the area frequency. I took off on Runway 18, and at 3 DME CV whilst still on climb to 8500 feet, a Mooney appeared in front flying from my right to left at the same level, in bound for Charleville. Since I had been monitoring both MTAF and Area and heard no inbound call I was unaware of the possible conflict." *Questionnaire response*

Airmiss

"A PA28 Cherokke was tracking east at 1500ft through the land of entry for Moorabbin. As the aircraft overflew the Newport Power Station, a PA38 Tomahawk flying north to south across the landed, also at 1500 feet, passed behind the PA28 at an estimated separation of 100 ft horizontal.

The PA28 had the Radar Advisory Frequency 135.7 MHz selected. The pilot called RAS but had received no reply. There was no communication with the PA38" *CAIR report (Note: there was some industrial dispute in the radar service at the time)*

Difficulties associated with maintaining separation

"I fly a high performance turboprop into a MTAF. From top of descent (in CTA) I monitor the MTAF frequency because at the 15 mile boundary I am three minutes away from the circuit (which is often

not enough time to work our separation if there are a number of aircraft operating). However because so many MTAF/CTAFs are 126.7 I hear every one and information is often lost by over transmitting making maintaining separation even more difficult" *Questionnaire response*

Pilots not operating in accordance with AMATS

"VFR pilot of single entered, landed and departed CTAF Aerodrome using the pre-AMATS procedures and frequencies" *Questionnaire response*

Frequency congestion/communication difficulties

"For my area (126.0) there is a massive increase in congestion on VHF (area). Often two together and awkward to get transmission out without jamming others. Also often CTAF transmissions jam VHF and vice-versa so one doesn't know how much area and circuit traffic one is missing" *Questionnaire response*

"Traffic in a large area (Mount Gambier, Kingscote, Eyre Peninsular, Whyalla and Port Lincoln) all audible to each other, jamming frequency (126.7) in an effort to separate each other. Communication becomes a joke and this is occurring with just airline operators without adding in charter and other operations." *Questionnaire response*

Airspace design posed difficulties

"On several occasions when operating into Esperance WA I have found that the 5nm CTAF is not big enough. I only have one radio so have to listen on Area frequency for aircraft not landing at Esperance. Skywest using high performance aircraft do not have time to assimilate traffic. CTAF should be 10nm." *Questionnaire response*

Communication problems with/for ATS

"Aircraft on which no flight details were held called Wagga Tower "VFR for Albury request climb to 6500 ft". It took three transmissions to obtain the pilots present position and preferred track" *Questionnaire response*

"Since the introduction I have mostly operated military helicopters in the Townsville areas and in Northern Queensland and the Northern Territory during Kangaroo 92. I have noticed considerable delays in getting Flight Service Officers to respond to VHF and HF communications. In the event of an emergency I believe they would miss my call probably inexcess of 50% of the time when I have good communications" *Questionnaire response*

Provision of IFR traffic information by ATS

"I believe traffic services given to IFR aircraft by FS can be misleading and contradictory. It occurs when an IFR aircraft is told "NO IFR TRAFFIC" when taxiing at a MTAF/CTAF even though another IFR aircraft may be in the CTAF/MTAF. Once that other aircraft has advised "CHANGING TO MTAF/CTAF" and prior to cancelling SARWATCH, FS denies its existence. The FS operator is forced to make a liar of himself when he says "NO IFR TRAFFIC" but knows very well that there is . He should say "NO IFR TRAFFIC OUTSIDE THE MTAF/CTAF". I realise that it is up to each aircraft to separate themselves within the MTAF/CTAF but believe it is misleading and dangerous for FS to make incorrect statements..." *Questionnaire response*

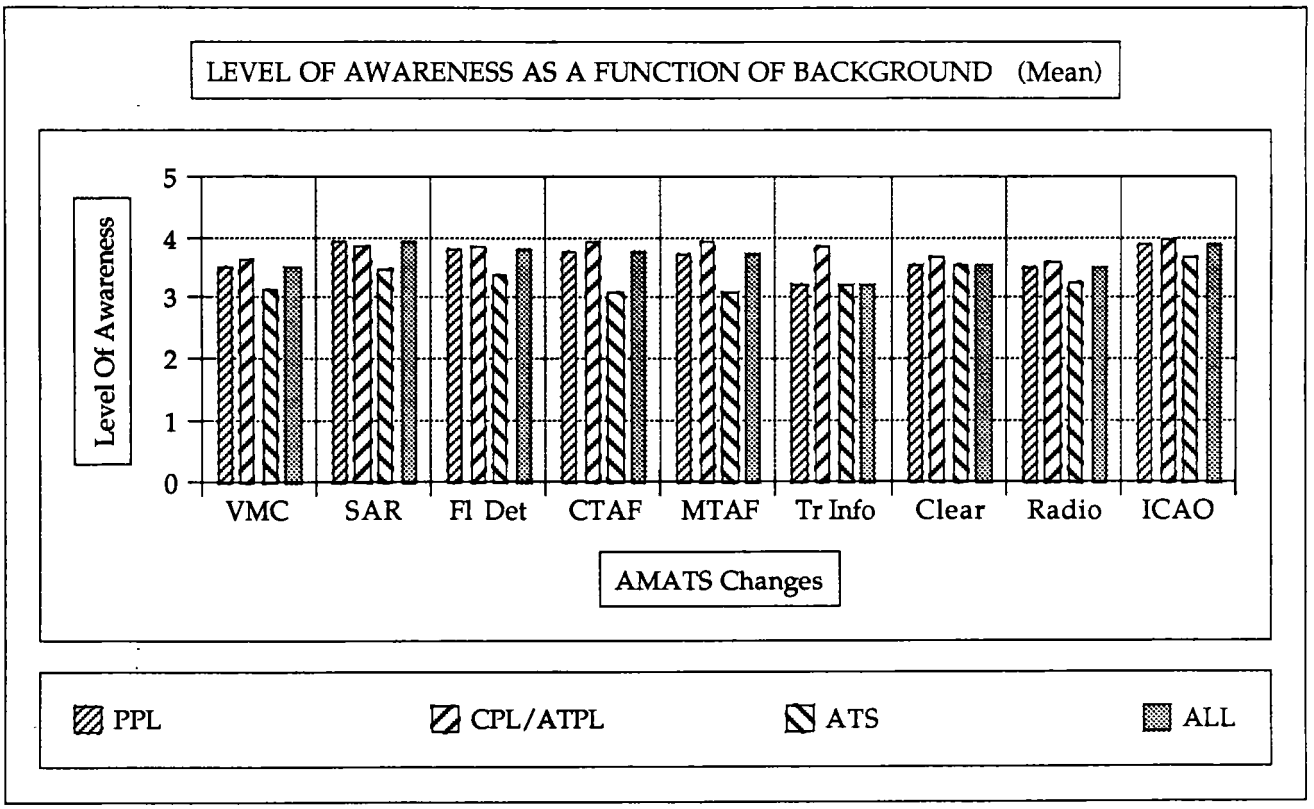
APPENDIX H

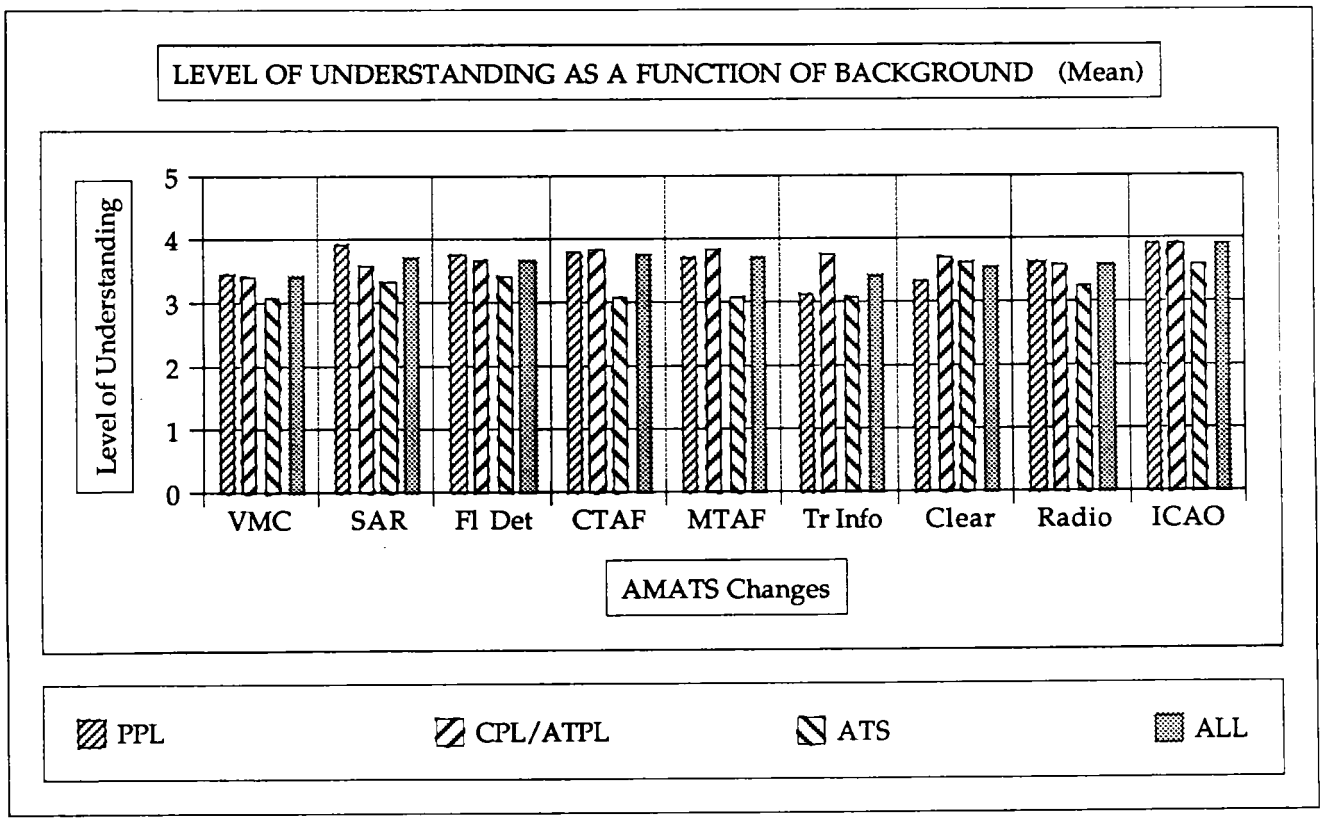
EVENTS

	TOTAL	OCTA	CTA/R	MTAF	CTAF
Communication problems which arose because an aircraft was on the wrong frequency	23	2		11	4
Aircraft failure to respond to calls	14	5	1	6	1
Aircraft in close proximity with no knowledge of each other	27	4		10	6
Airmisses	15	7		4	1
Difficulties associated with maintaining separation	8	1	1	4	
Pilots not operating in accordance with procedures	26	8	5	3	2
Frequency congestion/communication difficulties	10	2		2	
Airspace design posing difficulties	4	1			3
Communication problems for/with ATS	6	4	1		
Provision of IFR traffic information service by ATS	6	3		2	
Communication difficulties with ATS prior to entry into CTA	8	2	1		
Other	15	4		4	2
No report provided	58				

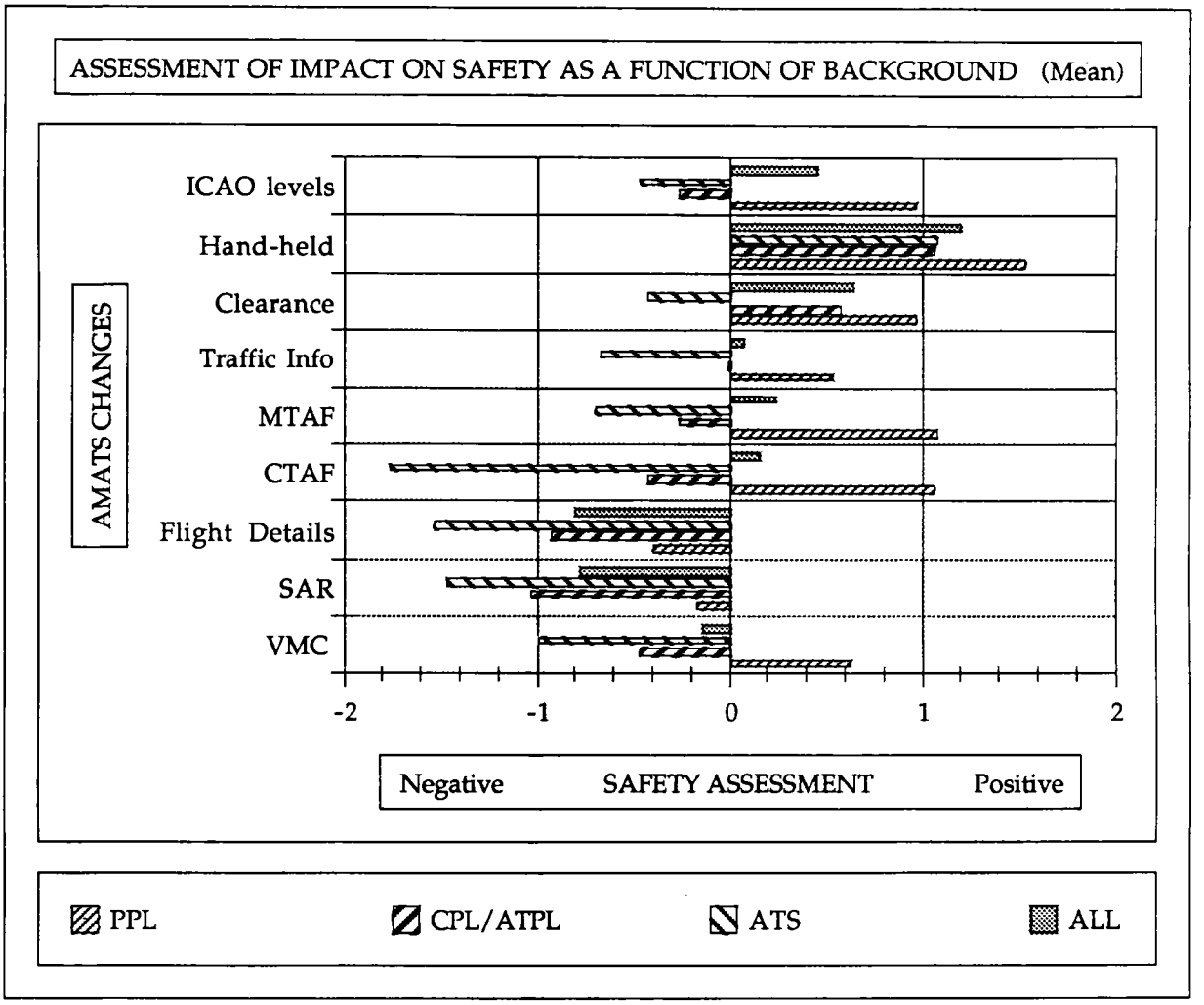
Note: In some cases the airspace in which the event occurred was not provided.

APPENDIX I


LEVEL OF AWARENESS AS A FUNCTION OF BACKGROUND (Mean)
Level Of Awareness
5
4
3
2
1
0
VMC
SAR
Fl Det
CTAF
MTAF
Tr Info
Clear
Radio
ICAO
AMATS Changes
PPL
CPL/ATPL
ATS
ALL


LEVEL OF UNDERSTANDING AS A FUNCTION OF BACKGROUND (Mean)
Level of Understanding
5
4
3
2
1
0
VMC
SAR
Fl Det
CTAF
MTAF
Tr Info
Clear
Radio
ICAO
AMATS Changes
PPL
CPL/ATPL
ATS
ALL

APPENDIX J


ASSESSMENT OF IMPACT ON SAFETY AS A FUNCTION OF BACKGROUND (Mean)
AMATS CHANGES
ICAO levels
Hand-held
Clearance
Traffic Info
MTAF
CTAF
Flight Details
SAR
VMC
-2
-1
0
1
2
Negative
SAFETY ASSESSMENT
Positive
PPL
CPL/ATPL
ATS
ALL

APPENDIX K

RATING OF EFFECTIVENESS OF CAA PUBLICATIONS
(1= ineffective, 5 = fully effective)

Airspace 91	3.5
All material published by the CAA	3.3
AIC 35/91	3.0