



# The ATSB Ansett Class A Investigation

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## **The ATSB Ansett Class A investigation**

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If human error on the part of one or two individuals can go unchecked within an organisation and result in a significant breakdown of the workings of the system, then the failure is a system error and not a human error.

Ansett Australia was a major Australian airline with a proud history and excellent safety record. However, in December 2000 and April 2001, a number of Ansett B767 aircraft were withdrawn from service because there was uncertainty as to the continuing airworthiness status of the aircraft. While this did not constitute an accident or incident, the Australian Transport Safety Bureau (ATSB) considered that it indicated a potentially serious safety deficiency and commenced an investigation. The scope of the investigation was subsequently widened to include aspects related to the Australian Civil Aviation Safety Authority (CASA), the manufacturer Boeing, the US Federal Aviation Administration, and aspects of the ICAO continuing airworthiness system. The ATSB report concluded that until the Ansett aircraft were withdrawn from service there was little awareness of the safety deficiencies that existed within the operator and at various levels within the international continuing airworthiness system.

Ansett was the sixth airline worldwide, and the first airline outside North America, to operate the B767. The introduction of that aircraft type into the Ansett fleet in 1983 was significant because the B767 had been certified under the then new damage tolerance design criteria. The Ansett B767 aircraft accumulated a high number of flight cycles because they were mostly flown on comparatively short domestic sectors.



**Figure 1: Ansett B767 VH-RMG at Sydney Kingsford Smith Airport June 1984**

In December 2000 and in April 2001, a number of Ansett B767 aircraft were withdrawn from service because certain required fatigue inspections of the aircraft structure had not been carried out. That led to uncertainty that the continuing airworthiness of the aircraft could be assured. In December 2000 the concerns related to possible fatigue cracking in the Body Station 1809.5 bulkhead outer chord, in the rear fuselage of the aircraft. In April 2001 the concerns related to possible fatigue cracking of the wing front spar outboard pitch load fitting that connected the engine support structure to the wing. In both cases undetected fatigue cracking had the potential to eventually lead to structural failure.

On 11 January 2001, the ATSB commenced an investigation into the circumstances surrounding the withdrawal from service of the Ansett B767 aircraft as the situation was regarded as indicative of a potential safety deficiency. On 10 April 2001 the ATSB investigation was extended to include an examination of the continuing airworthiness system for Australian Class A<sup>1</sup> aircraft such as the B767.

### **Damage tolerance design and certification**

The philosophy that underpins the design and maintenance of modern transport aircraft has evolved over time. The most recent approach to the control of fatigue and corrosion in aircraft structures is based on the concept of damage tolerance. The B767 was the first US-designed aircraft certified to damage tolerance standards.

The damage tolerance approach is based on the premise that while cracks due to fatigue and corrosion will develop in the aircraft structure, that process can be understood and controlled. Therefore safety will not be compromised. The key to the effective control of the process is a comprehensive program of inspections of the aircraft structure. Those inspections fall into three broad categories:

- zonal inspection carried out on a routine basis
- specific structural inspections developed from design based criteria
- Airworthiness Limitations Structural Inspections.

Airworthiness Limitations Structural Inspections are developed after the aircraft type has entered service, largely to address fatigue or corrosion problem areas identified through in-service experience or further testing and research. Because the Airworthiness Limitations Structural Inspections address concerns with a significant potential to affect the structural integrity of the aircraft the inspections are considered mandatory.

### **Fatigue cracks in the B767 Body Station 1809.5 bulkhead outer chord**

In June 1997, Boeing introduced the Airworthiness Limitations Structural Inspections program for the B767. The program was an essential part of the damage tolerance requirements and was designed to detect fatigue cracking in susceptible areas that had been identified through testing and in-service experience. Ansett staff did not initially recognise that some Airworthiness Limitations Structural Inspections were required by 25,000 cycles and a period of almost two and a half years elapsed before that error was identified. At the time that the inspection program was introduced, some Ansett B767 aircraft had already flown more than 25,000 cycles. In June 2000, further 25,000 cycle inspections were

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<sup>1</sup> Australian Class A aircraft refers to an aircraft with a Certificate of Airworthiness issued in the transport category, or one that is used for regular public transport operations.

introduced, including in the area of the Body Station 1809.5 bulkhead outer chord. Ansett did not initially act on this.

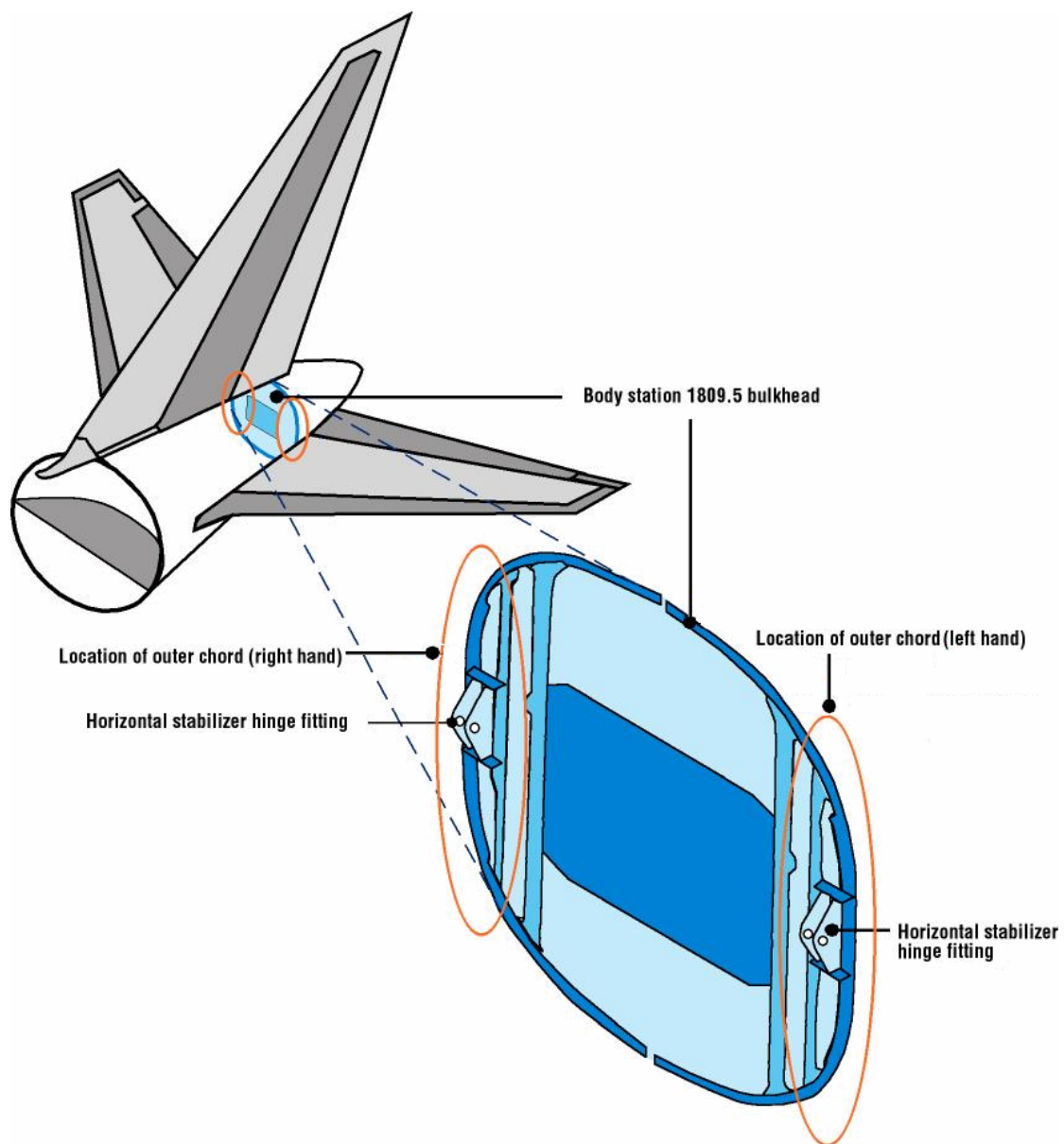


Figure 2. Location of B767 Body Station 1809.5 bulkhead

In December 2000, Ansett senior management became aware of the missed inspections and the aircraft were withdrawn from service on 23 December 2000. At that time, both Ansett and CASA were of the belief that compliance with the missed inspections was mandatory. Subsequent legal advice indicated that the regulatory basis for mandating compliance with the Airworthiness Limitations Structural Inspections for Australian operators was unclear.



Figure 3: Fatigue crack in an Ansett B767 Body Station 1809.5 bulkhead outer chord

### **Fatigue cracks in the B767 wing front spar outboard pitch load fitting**

In March 2000, Boeing issued an Alert service bulletin to detect and repair fatigue cracks in the wing front spar outboard pitch load fitting of the B767 engine mounting strut. Boeing recommended that the work be carried out within 180 calendar days. A revision to the service bulletin was issued in November 2000. The wing front spar outboard pitch load fitting was part of the upper link load path between the engine and the wing. Cracks in the wing front spar pitch load fitting could have caused possible loss of the upper link load path and separation of the strut and engine from the wing.

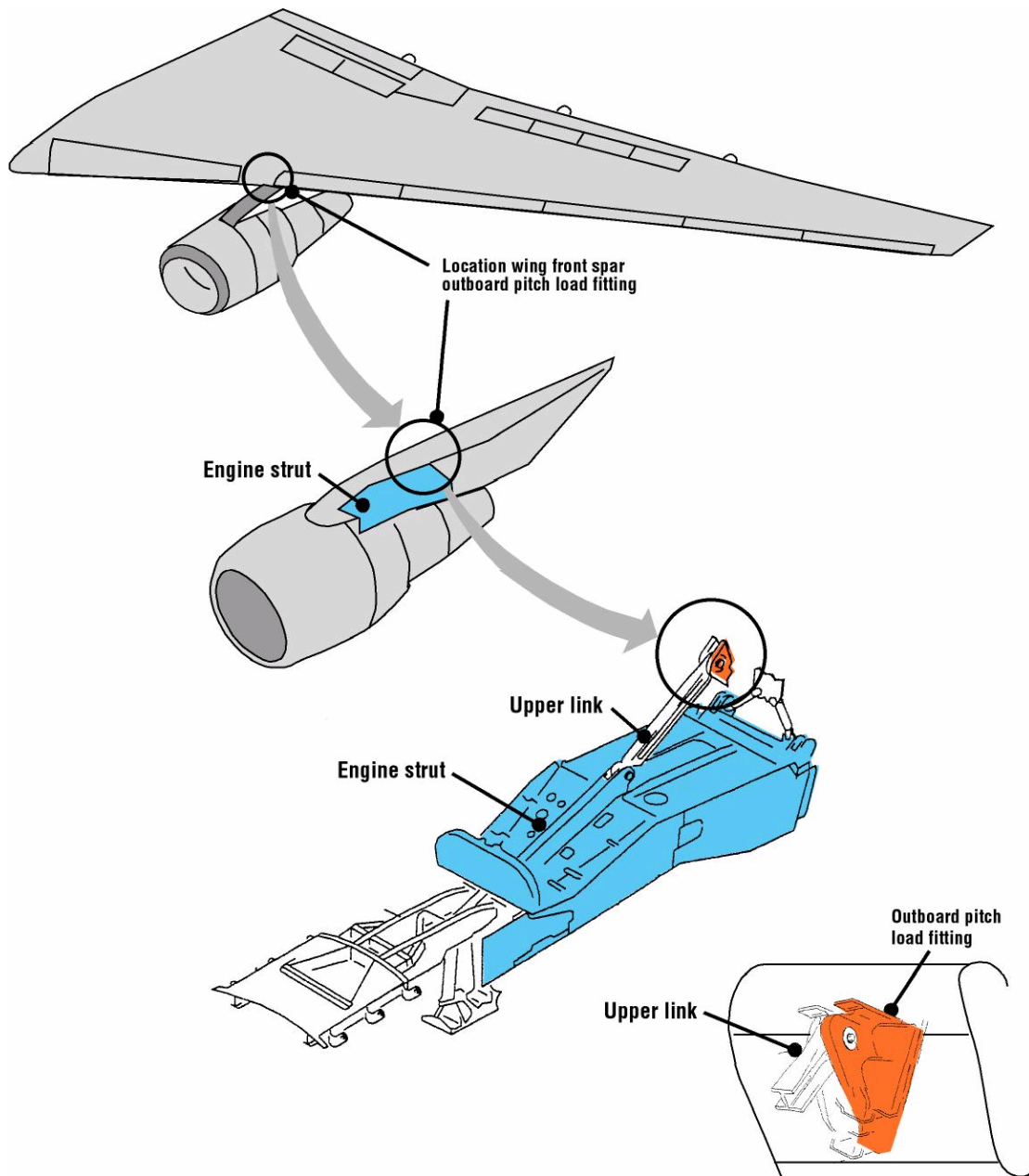


Figure 4. Location of B767 wing front spar outboard pitch load fitting

In March 2001, Ansett became aware that they had not acted on either the original or the revised service bulletins. During the period from 7 to 9 April 2001, inspections revealed cracks in the pitch load fittings of three of the Ansett B767 aircraft and they were withdrawn from service. On 9 April 2001 CASA required that a further four Ansett B767 aircraft be withdrawn from service.

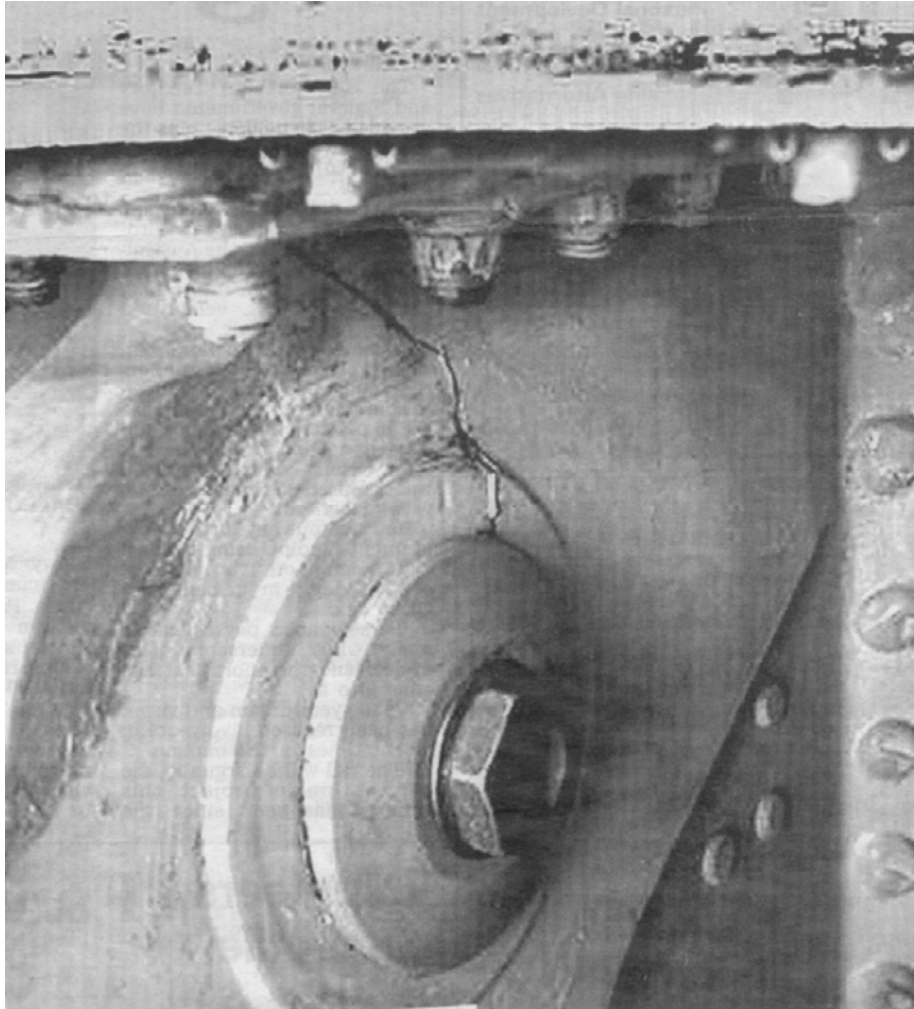


Figure 5: Fatigue crack in an Ansett B767 wing front spar outboard pitch load fitting

### **Deficiencies in the Ansett engineering and maintenance organisation**

The ATSB investigation found that there were systemic deficiencies within the Ansett engineering and maintenance organisation related to:

- organisational structure and change management
- systems for managing work processes and tasks
- resource allocation and workload.

These factors did not act independently of each other, but combined to greater effect, resulting in a loss of continuing airworthiness assurance<sup>2</sup>.

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<sup>2</sup> Continuing airworthiness assurance refers to the confidence that there are robust systems in place to ensure that the continuing airworthiness status of the aircraft is known at all times.



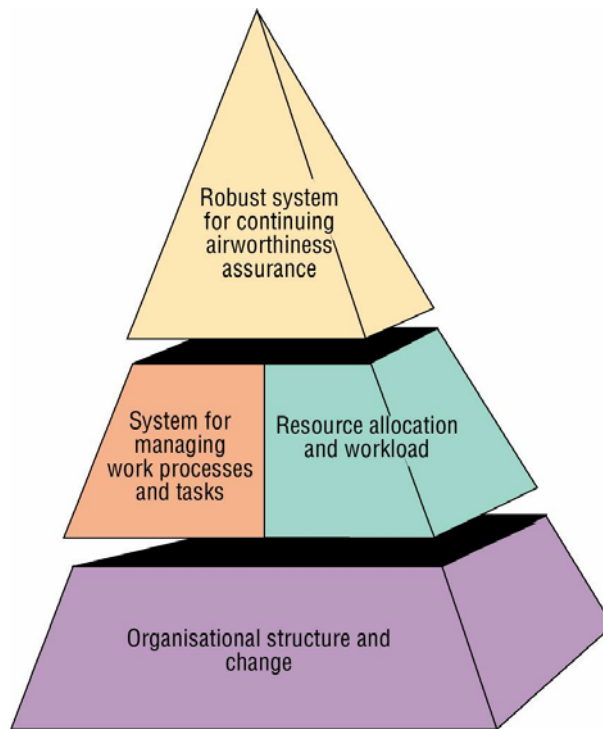


Figure 6. Factors affecting the Ansett system for continuing airworthiness assurance

Ansett had undergone considerable change over a number of years. Many of the Ansett systems had developed at a time when the company faced a very different aviation environment. Over time, efficiency measures were introduced to improve productivity but the introduction of modern robust systems did not keep pace with the relative reduction in human resources and loss of corporate knowledge. In addition, risk management and implementation of change within the Ansett engineering and maintenance organisation was flawed. Inadequate allowance was made for the extra demand on resources in some key areas during the change period.

The Ansett fleet was diverse and the point had been reached where some essential aircraft support programs were largely dependent on one or two people. Hence it was possible for an error or omission by a particular specialist to go undetected for a number of years.

Resource allocation and workload issues had been evident within some areas of the Ansett engineering and maintenance organisation for a considerable period of time. The investigation found that measures aimed at achieving greater productivity had been introduced throughout the organisation without sufficient regard to the different circumstances and criticality of the different work areas. Insufficient consideration had been given to the possible consequences of resource constraints on the core activities of some safety critical areas of the organisation.

Ansett staff had repeatedly expressed concern to senior Ansett engineering and maintenance management. Management suggested that work on some lower priority items could be halted in the short term. Putting non-urgent work on hold is at best a stop-gap measure. The danger is that even non-urgent work must be done eventually, and in time will itself become urgent. People and robust systems are two of the prime defences against error. Therefore, a combination of poor systems and inadequate resources has the potential to compromise safety.

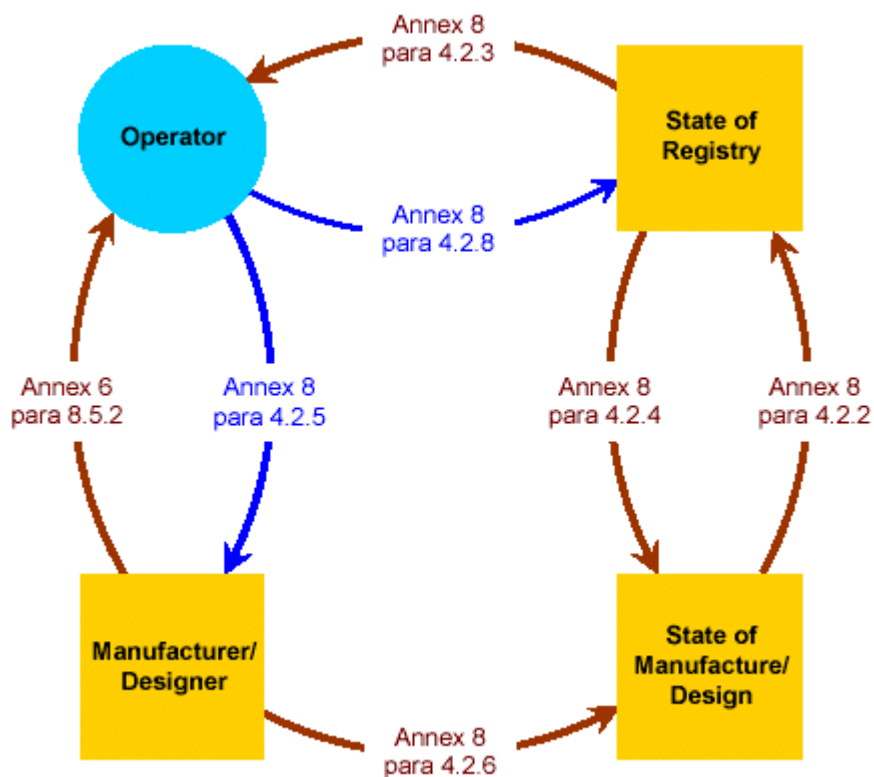


A number of deficiencies within the Ansett engineering and maintenance organisation identified in the Ansett Class A investigation were very similar to deficiencies that had previously been identified within the Ansett flight operations organisation. The deficiencies within the flight operations organisation came to light during the investigation of an accident that occurred in October 1994 in which an Ansett B747 aircraft landed with the nose-gear retracted, and sustained substantial damage to the fuselage<sup>3</sup>. However, although Ansett initiated an ongoing safety review and improvement process throughout the company in response to the 1994 accident, similar deficiencies in management processes within the Ansett engineering and maintenance organisation significantly contributed to the grounding of Ansett B767 aircraft in December 2000 and April 2001.

### **The international continuing airworthiness system**

The international continuing airworthiness system is essentially a complex communication system among all of the organisations responsible for the design, manufacture, regulation, operation, and maintenance of a transport aircraft type.

The operator is the focus of this communication system. They are both the initial source of much of the raw data that drives the system, as well as being the eventual recipient of the continuing airworthiness information that the system produces. The framework for these information flows between States, manufacturers/designers, and operators is outlined in ICAO Annex 6, *Operation of Aircraft*, and Annex 8, *Airworthiness of Aircraft*.



**Figure 7. The ICAO framework for continuing airworthiness information flows**

<sup>3</sup> BASI Investigation Report 1999403038 *Boeing 747-312 VH-INH, Sydney (Kingsford-Smith) Airport, NSW, 19 October 1994.*

The activities that are necessary for continuing airworthiness are outlined in the ICAO *Airworthiness Manual* (Doc 9760-AN/967, 2001). Some of the main elements include:

- aspects related to design criteria
- the publication of information for the maintenance of the aircraft, and the implementation of that material by operators
- the reporting and analysis of defect, accident and other maintenance and operational information, the transmission of recommended or mandatory action to operators, and subsequent action by the operator
- accomplishment by the operator of all mandatory requirements including fatigue life limits and any necessary special tests or inspections
- preparation of and compliance with Airworthiness Limitations Structural Inspections<sup>4</sup>.

The international continuing airworthiness system involves the activities of many different organisations. In many respects, the aircraft operator is the last link in an extended safety information chain in which each of the different organisations has its own unique perspective, objectives, and possibly conflicting priorities. That has the potential to affect the quality of the safety information that the operator ultimately receives.

The consistency and quality of the continuing airworthiness information that operators receive could be improved if all parties designed their practices to ensure that they worked towards clearly articulated end objectives for the entire international continuing airworthiness system, as well as any other domestic requirements.

The ATSB Ansett Class A investigation found that the responsibilities of the individual parties in the international continuing airworthiness system are not adequately defined to ensure that the entire system is not compromised by the action, or inaction, of one party.

The continuing airworthiness system should have inherent resilience to allow operators to be confident that the information continuing airworthiness they receive, and rely on, is correct, timely, and complete. Inherent resilience will allow the system to tolerate unexpected deviations that could result in pre-defined tolerances or limitations being exceeded.

### **The Australian Civil Aviation Safety Authority**

The ATSB investigation found that based on the Ansett B767 experience, the Australian system for continuing airworthiness of Class A aircraft was not as robust as it could have been, as evidenced by:

- uncertainty about continuing airworthiness regulatory requirements
- inadequate regulatory oversight of a major operator's continuing airworthiness activities
- Australian major defect report information not being used to best effect.

No evidence was found to indicate that CASA had given formal consideration to monitoring the introduction of the B767 Airworthiness Limitations Structural Inspection program by Ansett.

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<sup>4</sup> The ICAO *Airworthiness Manual* uses the term Supplemental Structural Inspection Programs. The Supplemental Structural Inspection Program is the term used to describe one possible means of compliance with the mandatory Airworthiness Limitations Structural Inspections.

Prior to December 2000, there was apparently little or no awareness within CASA of the underlying systemic problems that had developed within the Ansett engineering and maintenance organisation. The presence of organisational deficiencies remained undetected. In addition, there were delays in adapting regulatory oversight of Ansett in response to indications that Ansett was an organisation facing increasing risk.

The decision by the then Civil Aviation Authority in the early 1990s to reduce its previous level of involvement in a number of safety-related areas did not adequately allow for possible longer-term adverse effects. This included reducing the work done by Authority specialist staff in reviewing manufacturer's service bulletins relevant to Australian Class A aircraft, and relying on operators' systems and on action by overseas regulators in some airworthiness matters.

CASA subsequently initiated a comprehensive review of its systems to monitor, assess, and act on service bulletins, to ensure that those critical to safety could be readily identified and acted upon appropriately. Recommendations from that review were addressed in an associated implementation plan that detailed the nature and timing of the actions that CASA would take in response to the recommendations.

### **The US Federal Aviation Administration**

Delays by the US Federal Aviation Administration contributed to a lack of awareness by Ansett and CASA of required B767 Airworthiness Limitations Structural Inspections. In August 1997 the FAA foreshadowed an airworthiness directive to mandate compliance with the June 1997 *Maintenance Planning Data Document* section 9 revision. However, the airworthiness directive was not issued until approximately three and a half years later. This delay had the potential to result in poor safety outcomes.

Timely action by the FAA in issuing a relevant airworthiness directive had the potential to alert Ansett, CASA, and other operators, to the process in train to mandate the B767 Airworthiness Limitations Structural Inspection program, and of the time frame specified for compliance with that program.

A breakdown in process within the FAA also resulted in a delay by the FAA in issuing an airworthiness directive in relation to the Boeing Alert service bulletin concerning the B767 wing front spar outboard pitch load fittings. The initial service bulletin was issued by Boeing in March 2000, but the FAA did not issue an airworthiness directive in relation to the bulletin until April 2001.

There has been evidence of significant and endemic delays in the FAA rulemaking process over many years, and the events of December 2000 demonstrated the potential consequences of such delays. The ATSB Ansett Class A report recommended that it would be prudent for States of Registry to consider the potential impact that delays in the FAA rulemaking process could have on the continuing airworthiness assurance of US-designed and/or manufactured aircraft types on their register.

In response to the circumstances of the events of December 2000 and April 2001, the FAA has included further checks and balances designed to ensure that all service bulletins issued by US manufacturers are properly reviewed and addressed. In addition, the FAA has established an 'early warning system' to provide non-US airworthiness authorities with

information on pending occurrence investigations that may result in mandatory action by the FAA.

### **Lessons to be learnt**

The events depicted in the ATSB Ansett Class A report clearly demonstrate that a combination of inappropriate systems and inadequate resource allocation can lead to undesirable outcomes. This is because people and robust systems are two of the prime defences against error in complex safety-critical systems, such as aviation. Both people and systems can detect and mitigate the effects of errors, from whatever source.

Consequently, all aspects of the air transport system must have effective mechanisms in place to detect and mitigate the effects of human error if it is to remain safe. If a failure by one or two individuals can result in a failure of the system as a whole, then the underlying problem is a deficient system, not human fallibility.

The situation that developed within the Ansett engineering and maintenance organisation was the result of particular events and circumstances over an extended period of time. However, other environments could give rise to a similar situation, and therefore potentially lead to similar results. All operators should be aware of the potential for a combination of less than fully developed systems and stretched human resources to compromise continuing airworthiness assurance.

Even a relatively small air operator should not under-estimate the complexity of ensuring the continuing airworthiness of its fleet. The international system is, by necessity, very complex. It is made up of a number of large organisations that have to work together to make another, larger, system work effectively.

In any complex system, subtle changes over time can lead to the development of situations that may result in unforeseen consequences. Without effective monitoring, the system may slowly deteriorate until it is no longer capable of performing the task for which it was originally intended. A gradual transformation may mask the effects of change until a combination of events leads to a rapid and severe readjustment. It is possible to see the situation that developed within Ansett in this light.

Ansett had undergone considerable change over a number of years. Many of the Ansett systems were developed at a time when the company faced a very different aviation environment. A number of significant changes had taken place since 1990. These changes included the ending of the two-airline policy in the domestic airline industry and the introduction of a 'user pays' principle that required industry and users of the system to cover a significant part of the cost of the provision of air safety services.

Over time, efficiency measures were introduced to improve productivity within the Ansett organisation. However, as Ansett emerged from the earlier protected environment, the equally necessary introduction of modern robust systems did not keep pace with the relative reduction in human resources. Therefore a situation gradually developed in which the nature of the Ansett system fundamentally changed. That eventually had unforeseen, and undesired, consequences.

Until Ansett withdrew their aircraft from service, there was apparently little or no awareness within Ansett or CASA of the underlying systemic problems that had developed within the

Ansett engineering and maintenance organisation. The presence of organisational deficiencies remained undetected.

The question that naturally arises is “How could this have happened?” The answer may in part lie simply in the need to be mindful.

The concept of ‘organisational mindfulness’<sup>5</sup> has been developed to help understand the successful operation of ‘high reliability organisations’. High reliability organisations operate in an environment where it is not prudent to adopt a strategy of learning from mistakes. The essence of organisational mindfulness is the idea that no system can guarantee safety for once and for all. Rather, it is necessary for an organisation to cultivate a state of continuous mindfulness, or unease, and always be alert to the possibility of system failure<sup>6</sup>.

The preoccupation of high reliability organisations with possible failure means that they are willing to accept redundancy. They will deploy more people than is necessary in the normal course of events so that there are extra resources to deal with abnormal situations when they arise. This means that staff are not routinely placed in situations of overload that may adversely affect their performance.

While high reliability organisations are preoccupied with failure, more conventional organisations focus on their successes. They use success to justify the elimination of what is seen as unnecessary effort and redundancy, and they interpret the absence of failure as evidence of the competence and skilfulness of their managers. This focus on success breeds confidence that all is well, and leads to a tendency for management and staff to drift into complacency.

Australia has a long-standing reputation as a world leader in safe aviation operations. However, this investigation indicated that there were a number of deficiencies within the system for ensuring the continuing airworthiness of Class A aircraft in Australia. These deficiencies occurred within the operator concerned, Ansett, the regulatory body of the State of Design, the FAA, and the Australian regulatory body, CASA.

That those safety deficiencies went undetected, both within the operator and within the regulators, for an extended period of time, raises the question as to whether Australia’s historically good aviation safety record led to a degree of complacency within the aviation safety system.

The world aviation system has undergone considerable change in the last decade, and Australia has been no exception. Economic deregulation and changes in the commercial environment have been accompanied by equally major changes in the regulatory sphere, resulting in many improvements in safety and efficiency. Nevertheless, periodic review is needed to ensure that existing systems for maintaining air safety keep pace with the changing environment.

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<sup>5</sup> Weick KE and Sutcliffe KM (2001). *Managing the unexpected: Assuring high performance in an age of complexity*. Jossey-Bass: San Francisco, USA

<sup>6</sup> Similar safety concepts have been described as ‘chronic unease’ (Reason, 1997) and ‘requisite imagination’ (Westrum, 1993).

## References and Bibliography

Copies of ICAO Annexes and other ICAO publications can be obtained from ICAO (<http://www.icao.int>). For further information contact the ICAO Document Sales Unit ([sales@icao.int](mailto:sales@icao.int)).

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### **Online Resources**

Air Transport Association

ATA Spec 113: Maintenance Human Factors Program Guidelines

<http://www.air-transport.org/public/publications/display1.asp?nid=938>

Boeing Human Factors products and services

<http://www.boeing.com/commercial/ams/mss/brochures/humanfactors.html>

FAA Human Factors in Aviation Maintenance and Inspection (HFAMI)

<http://hfskyway.faa.gov/>