Why we Regulate The Way we Regulate and Who Pays.

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Preface

This is a paper concerning :

The philosophy of government control of aviation

the history of Government control in Australia

CAA as a Government business enterprise,

the capture and competence of the CAA

technical authority and leadership on the part of managers in CASA

unsafe cognitive dissonance in the industry,

the arrangements for engineering investigation of the safety of types of aircraft registered in Australia,

organizational separation of the ATSB from the CASA .and

responsibility for regulations relevant to the ditching of Westwind aeroplane at Norfolk Island, and to overseas maintenance of Australian aircraft.

I was formerly a Chief Airworthiness Engineer in the Civil Aviation Authority, and a member of the Air Navigation Commission's Airworthiness Panel. I am a graduate of the University of Sydney in Aeronautical Engineering, the RAAF Academy, RAAF Basic Flying Training School, and the RAAF Staff College. I have been elected as Associate Fellow of the Australian Institute of Management and an Associate Fellow of the Royal Aeronautical Society. I have 30 years experience in airworthiness control, especially of aging aircraft, and including numerous accident investigations.

I have made this submission because, with all due respect to the Director and his staff, I strongly suspect that several basic principles of achieving safety in aviation have gone missing in action. CASA appears to be entrenching policies that were forced upon the "captured" CAA in times of financial stringency, and yet corporate management appears to be gold plated. ATSB continues to be ineffective and administrative separation of ATSB from CASA, and CASA from the AGPS, are taken for granted. Is CASA to become little more than a client of the European Airworthiness Authority, the FAA or, manufacturers, and incapable of independent thought and action.

Contents

Regulating

Regulatory Principles

What is "Regulation" ?

regulate *vt* to guide or restrict, to cause to conform to a standard condition

The objective of the civil aviation authority is, and has always been, in brief, to prevent aviation accidents. It really is as simple as that. One might concede to " regulate civil aviation for the purpose of preventing accidents", but why does the Act say,

"CASA has the function of conducting the safety regulation of the following, in accordance with this Act and the regulations:" followed by a brave attempt to list the activities needed for that purpose.

Semantically, one cannot directly regulate safety. One cannot regulate the absence of risk.

So it is not safety that is regulated but the condition and operation of an aircraft or of an airfield or an airway etc, and clearly they are also the domain of manufacturers and operators. The Act limits the responsibility of the CASA to the conducting of the regulation, "administration" may have been a better word. The Act thereby relieves the Commonwealth of most of the responsibility for the condition of an aircraft – though this has yet to be tested.

Ultimately, the administration of the regulation of aviation safety amounts to regulating the activities of people. That is important.

Why Regulate

To begin at the beginning, governments regulate for the economic welfare of the people of their countries, when market forces will not always operate for the betterment of that welfare, and when the principle of buyer beware is not sufficient to protect buyers who lack influence and knowledge.

Governments regulate when common law cannot provide sufficient and timely remedy after the event - especially if the event cannot be foreseen by the disadvantaged.

The framework of this regulation is one in which it is accepted that a duty of care exists towards one's fellows, and that the requisite standard of care is higher if they are naive or if one is making money from them.

The need for transport safety regulation thus depends upon the proposition that the tort liability system will not lead to a socially acceptable level of risk. The strength of that proposition varies from country to country, but, nevertheless, all countries have a regulatory system that tries to prevent hypothetical accidents that might occur to unnamed people at some time in the future - in preference to relying solely on fixing the problems of a particular injured person after they occur.

Texts on transport economics hold that it is axiomatic that transport will require government regulation to achieve economic efficiency and to ensure the safety of the citizens. Society has become used to transport safety regulation.

The following five concepts are important in aviation safety regulation:

Firstly there is the matter of standardising behaviour when people are interacting with one another in a way that could be dangerous. The rules of the road are a good example.

Secondly, people psychologically have difficulty in assessing the true risk in low probabilities. Further, where expectations are small, people tend to risk-aversion in considering gains, whereas in considering losses they tend unreasonably to be risk takers.

Thirdly, transport matters are very complex and it is neither economical nor realistic to expect each person to be so expert on safety matters as to make sound choices.

Fourthly, no single manufacturer or operator can afford to adopt costly safety precautions without a guarantee that competitors will do the same.

Fifthly, risky choices have unanticipated and often unappreciated bad effects on people other than those making the choice. People tend to invest less in safety than is necessary; and less than they might have been prepared to pay had they known others would be hurt. A hazard which may not warrant significant change in personal behaviour, because the risk to the individual is relatively small when compared to the individual risks of routine activities, or the risk incurred when changing behavior, may warrant mitigation because of the number of people exposed to the risk.

The objective of ensuring safety of flight cannot be left to enterprising but unregulated operators or to a doctrine of survival of the fittest.

The aim is to restrict the propensity of aircraft to cause injury, financial or physiological, to people before they can exercise an informed freedom of choice and avoid unwanted risk.

If we look back over Australia's regulatory practices and attitudes in aviation they will be seen to have echoed the reasoning of the past few paragraphs. In particular we have categorised our regulations about the requisite standard of care according to the revenue earning capacity of an aircraft, and to the propensity of an aircraft to cause injury to people.

Somewhere along the way, the classification of types of operation came unglued – of which more anon.

Who Should Pay

Pay for What?

There is a need for rigour in the definition of the cost of regulation. If a regulation required the keeping of records which the operator would not otherwise have kept, is the cost a cost of regulation? If a regulation required fitment of equipment which the operator would not otherwise have installed, is that cost a cost of regulation? Flight Data and Cockpit Voice Recorders are a case in point. They are not necessary for the safe operation of the aeroplane to which they are fitted but the manufacturer is required by regulation to fit them or provide for their fitment.

The cost of interest to this Review is the cost of CASA's *administration* of aviation safety regulation.

Indeed, the organization might better be renamed Civil Aviation Safety Administration.

At What Price

The administration of aviation safety regulation falls under the definition of a public good. A public good is "nonexcludable", meaning that the cost of excluding from the benefits of the administration of aviation

regulation, those people who do not pay for it, is prohibitive – that is , it costs too much to keep out free riders. The use of a public good by one individual does not reduce its availability to any other individual. An individual cannot chose not to use a public good. Under those circumstances no private organisation will produce a public good. Public goods are those which may be furnished free to an individual but are produced at a cost to society as a whole. They are paid for by society as whole because otherwise they would not be produced on time, or at all, or would not be as equally available to everybody as is desirable. If society requires a public good, the good must be produced either by government directly or by an organisation established or engaged by government and funded from moneys raised by government.

If the administration is delegated to a body of officials, the officials will be recompensed and other expenditure authorised in the usual parliamentary way.

If the administration is delegated to a body corporate, the body corporate will be producing public goods as a service to government, and it should, in principal, be recompensed in the normal commercial way. That is on the basis of a contract to perform a specified amount and type of work .

And therein lies the source of the seemingly perpetual funding difficulties of the CAA and CASA. The quantity and type of work to be done has never been specified in sufficient detail to permit the Authority to calculate its costs.

As a consequence, the Authority has been funded on the basis of "here is a small bucket of money , do as much administration with it as you can." Thus the Authority has been continuously navel gazing – examining and revising its role and changing shape to suit a reduced capability.

The Distribution of Pain

. The following Table provides some information on. who bears the costs of accidents. Over thirty percent of the cost falls upon people who had no part in the decision to fly.[1] The kin of the casualties are often the real victims. So too are the almost anonymous colleagues and business shareholders of the casualties.

TABLE Distribution of the costs of aviation accidents - Australia 1988 Source: Australian Bureau of Transport and Communications Economics (3) Data are for 328 accidents, involving 633 people, with 70 fatalities and 102 injured.

Losses to	**Value $M**	**Percent of Total**
Casualties		
earnings	15.0	38%
pain, suffering	2.1	
Aircraft Owners		30%
aircraft damage	13.8	
Rest of Society		32%
production (a)	7.1	
insurance admin	5.8	
medical	0.8	
search, rescue	0.3	
investigation	0.1	
other	0.3	

[1] This table also makes an important comment on the fashionable proposition that private and recreational aviation should not be regulated because any accident would affect only those who willingly took the risk.

(a) Excluding product value of casualties' earnings..

Society as a whole bears a large proportion of the costs of the poor practices or decisions by the aviation industry that lead to accidents in Australia.

In some countries, the financial costs, the price of medical, legal and administrative services lie where they fall. In others, they are met most directly by government or institutions. Does this have a bearing on whether private/business aviation is regulated strictly or not? Ultimately of course, the diverted effort is always an economic cost to society.

However, it is fairly clearly the general public who should be specifying how much danger is acceptable and not the aircraft owners or operators. He who would call the tune must expect to pay the piper. There is a reasonable hypothesis to be made that those who suffer from, who bear the costs of, aviation accidents, are also those who would gain from a higher standard or a greater intensity of regulation.. They should, accordingly, pay the cost of administering regulation.

Cost Benefit Analysis

One of the more common cries from the industry, and from other arms of government, a proposal that has some superficial intellectual appeal, especially to those who dislike trusting technocrats.[2] is that all proposed aviation safety regulation should be tested by cost-benefit analysis before implementation.

In the aftermath of each successive aviation catastrophe, however, the public cry has been that such a concept is outrageous. "You must not put a value on human life!"

Both opinions are most often expressed extempore or off-hand of course, and with little appreciation of just what is being said.

The matter is discussed in Appendix A

When one pays for aviation safety one pays for a reduction in the risk of an accident. The risk is all but immeasurable and the dollar value of reducing it is inestimable.

Cost-benefit analysis is neither appropriate nor practicable in aviation safety regulation. The resulting bald and mainly hypothetical cost-benefit arithmetic, divorced from discussion of the issues essential to the political decision to regulate or not to regulate is of no value.

The class of analysis proposed is unlikely ever to address the issues which should determine whether a proposed safety regulation is implemented or not.

[2] A proposition with similar appeal is that the content of all proposed aviation safety legislation should be the subject of industry consultation before promulgation.

It is one thing to write down what we know of a project's costs and benefits. It is quite another thing altogether to base a decision on the differences between the figures on the left and right hand side of the resulting ledger.

Regulatory Practice

Delegated Legislation

The Parliament of the Commonwealth of Australia receives its authority to make laws about international, interstate and, intrastate aviation safety, in consequence of a lengthy and complex judgement of the High Court of Australia. [3]

In Section 51 of the Constitution, the States empower the Commonwealth to make laws with respect to commerce between the States and on Australia's external affairs, which include the Convention on International Civil Aviation to which Australia is a signatory.

The High Court of Australia has ruled that considering the continuity of aviation across Australia, the Commonwealth's compliance with ICAO standards and recommended practices for international aviation safety necessitates that consistent standards and practices, *mutatis mutandis*, should apply to interstate and intrastate aviation safety. Appendix B presents some relevant details of prior Australian regulatory history.

Historically, Parliament designated a body of officials, servants of the public, to perform general functions thought to be necessary for the administration of the regulation of aviation safety. No Cabinet or parliamentary party had the time or continuous organic contact with aviation safety administration to enable it to do this work. Most of the policy preparation was done by these officials. Proposed policies were formulated out of the experience and foresight of men in constant administrative contact with the facts and circumstances of aviation safety. The policies were scrutinised by the Minister and were accepted, amended or rejected. Cabinet accepted the responsibility for all decisions; and Parliament acted as a public watch dog against caprice, injustice, anomaly and hardship. This was the surest and most immediate safeguard the people possessed.[4]

It was considered that the officials, who represented an element of continuity in the structure of the executive, should supply the experiential bases for the consideration of policies by their Ministerial chiefs.

The processes for selecting and remunerating officials evolved to ensure this was so.

Capture

Regulatory practice changed in 1987/88. Instead of designating a body of officials, the Parliament appointed a body corporate to perform the aviation safety functions. BASI was identified as the "watch dog" which was to keep the new body on the straight narrow. The immediate convenience to the Government was that aviation safety funding came "off Budget", and a whipping boy was created to shield the Minister by absorbing the complaints of the industry. The body corporate, the CAA, was to be funded by the proceeds of providing

[3] Airlines of NSW Pty Ltd v New South Wales (No 2) [1965] HCA 3; (1965) 113 CLR 54 (3 February 1965)

http://www.austlii.edu.au/au/cases/cth/high_ct/113clr54.html

[4] vide Crisp L.F. The Parliamentary Government of the Commonwealth of Australia 3ed Longmans London, 1961, pp 242 et seq.

"regulatory services" to the industry. Most importantly, though it was not seen that way at the time, Australian Government Public Service norms for personnel establishments, classification, salaries and appointments were set aside. Those norms in fact act as safeguards. Removing them rendered the CAA susceptible to capture. Although a very senior and relevantly experienced public servant was made the Chairman of the CAA board, and another, the CEO and General Manager of the Authority, with the right to hire and fire staff, within two years, following the death of the Chairman of the Board, Board member R.H. Smith had become Chairman, the CEO and his deputy had involuntarily "resigned", and Mr Smith's nominee had become CEO. The Authority had been captured.

Rule Changes in Captivity

The corporate objective became "Impose the minimum of regulatory constraint and associated costs to the aviation industry consistent with maintaining a high level of safety, and develop as far as possible the concept of self-administration by industry of safety requirements, with oversight by the CAA."

In a trice, all of the following rule changes were made against the express advice of the safety regulation specialist staff in the CAA.

The first change was to permit an owner to have the registration mark for their aircraft changed at will. This mark is the principal method of identifying an aircraft. The effect of the new rule was to allow some people to disguise the fact that their aircraft had had a poor history. It had the more important effect of disconnecting the aircraft from the records in the CAA of the aircraft's past defects.

The maintenance rules were changed so that Australian aircraft could be maintained by anyone who had a relevant licence issued by an ICAO member nation instead of an Australian licence. The need to have a system of quality control approved by the CAA was removed. The impetus for this change came from the owners of general aviation aircraft engaged in crop-spraying or photo-survey, or passenger charter overseas who wanted to have their aircraft maintained overseas. However, under the changed rule, Qantas could have had their aircraft maintained in Honduras if they wished.

The CAA simply could not at that time oversee maintenance done outside Australia. It could not exercise proper quality assurance. The overseas airworthiness authorities had no real interest in the rights of the people of Australia. The CAA did not have any legal jurisdiction over foreign companies. The CAA could not fine them or take away their approvals. The CAA did not know if an Australian aircraft was being operated and maintained overseas despite the fact they were legally responsible for such aircraft. Overseas maintenance organisations were under no obligation to follow Australian rules... Australian ADs and other special inspections could be overlooked. Major defects found were not reported to the CAA. The Authority lost control of a portion of the Australian fleet.

Next there was a tidy little group of changes. The mandatory requirements for safety factors on runway distances for take off were cancelled. This applied to charter aircraft below 5700kg. Then the same was done for runway lengths for landing - except that this applied to all private aeroplanes as well.

The CAA cancelled the Regulation that had permitted the CAA to prescribe minimum quantities of reserve fuel to be carried.

The CAA cancelled the rule that required aeroplanes flying to Lord Howe Island to carry enough fuel to fly back to the mainland if bad weather prevented them from landing on the island.

Then the Regulation permitting the CAA to prescribe aerodrome standards was cancelled.

The immediate consequence of that particular group of changes was to permit certain executive jets to fly to Lord Howe Island.

The next change was to permit pilots to use, for guidance in the safe operation of their aircraft, flight manuals which had not been approved by any safety regulatory authority. The motivation here was to remove one of the important mechanisms by which the Authority regulated the industry.

Then the Authority changed the rules so as to permit fare paying passengers to be carried in ex-military aircraft, replica aircraft, and allegedly historic aircraft - while at the same time exempting those aircraft from normal design requirements and maintenance regulations.

Helicopters were the next to benefit. The standard of performance expected in the event of an engine failure was markedly lowered. Twin-engined helicopters flying over water were no longer required to be able to fly on one engine - not even those carrying passengers.

Then helicopters were permitted to fly over populous areas regardless of their inability to reach a safe landing area in the event of an engine failure.

The rules were also relaxed to allow helicopters to fly close to buildings and people.

In a complementary relaxation, all aircraft were allowed to fly as close to other aircraft as the pilot considered safe. The CAA's right to prescribe clearances was removed.

At that time Mr R.H. Smith owned and operated a Bell 206 helicopter.

Next the requirement for aircraft flying on instruments to have an autopilot was taken away. This applied to most aeroplanes below 5700kg, including those chartered to carry passengers.

Then the flying training lobby had a go. The number of flying hours required to qualify for a CPL was reduced. The same happened for the PPL. SPL holders were allowed to carry passengers. The qualifications required of flying instructors were lowered.

During this period, there was a small airliner which the CAA's engineers refused to certificate because its design didn't meet the standard safety requirements. Amongst other things the control system did not have all of the duplication necessary for safe airline operation. The engineers were over ruled and CAA management itself certificated the aeroplane. Ironically the important changes sought by CAA engineers were subsequently made mandatory by the FAA. That sort of irony is quite common.

The regulations were changed to require the CAA to automatically accept any aircraft type that had been previously approved overseas - regardless of how old or how bad the design was known or suspected to be. This was a very popular change amongst the deregulationists . It was something of a cause celebre. It was seen as critically curtailing the CAA's power. The appropriate consultant was chosen to recommended that course of action, and following his report he was promptly appointed to the Board of the CAA. His son was later employed in a senior position by the Authority.

Another important change was that the burden of proof was shifted. Whereas in the past anyone who wanted to relax the rules had to make a case that things would still be safe; now, the CAA was required to prove conclusively that things would be unsafe. Officers of the Authority were forced to re-justify internationally accepted principles a priori.

The maintenance regulations were reworded to include phrases like "the Authority must approve".

A CAA mission statement was devised which emphasised deregulation.

A blind eye was turned to the operation of ultralight aeroplanes, contrary to the requirements of the House of Representatives Standing Committee on Transport Safety.

The only motivation for the changes had to be the pressure being applied by the deregulationists. Those people who stood to benefit from the changes. The changes certainly cannot be put down to the CAA as a body of engineers and inspectors..

All this was done in the name of *"affordable safety"* .

It was not long before the Corporate Plan was to "provide Australian regulations that are not more restrictive than regulations accepted in other leading aviation countries unless assessment against objective criteria necessitates a difference."

BASI the watch dog did not act to challenge those changes.

Uniquely Australian Rules

Some Australian rules were different from those overseas. Much of the difference was to do with the way overseas industry grew up vis a vis the regulator. and also to do with social attitudes about private enterprise freedoms versus the public interest. But they were not different in the well established principles. Those were common to the rest of the world. The difference was in the advanced technical detail. Australia was not under the thumb of the manufacturers or major airlines and had independent technical expertise of its own.

The Australian economy is more highly dependent on aviation and therefore on aviation safety. Much of the economic dependence is on small aircraft. Australia has hundreds of ten-seat light aeroplanes masquerading as airliners and carrying people around on their daily business.

For those reasons Australia put in the effort and Australian rules were in advance of other countries. Never the less the Regulations and Orders were always traceable to ICAO principles. It was quite common for the USA and the UK to adopt rules equivalent to the "unique" Australian rules, but it was a protracted affair.

On each occasion the Australian rules were tested in service they proved superior to the USA rules. This was so from Bell 47 helicopters to Boeing 747. Australia lead the way with weather radar, flight data recorders, full scale fatigue testing, airworthiness requirements for fibre reinforced plastic, landing aids and so on.

The Socially Acceptable Risk

Many eminent people have expressed their opinion on the required level of safety in aviation:

"Safety is a relative concept and it is important that any discussion of safety adequacy recognizes this fact."

J. Enders 1984 "

"...absolute safety toward which we strive is not realizable, but poses a constant challenge."

"Though they may be privately employed, aircraft engineers are all public servants in the sense that each has an obligation to provide the highest degree of care in the public interest. The law of course demands this."

J. Lederer 1965 .

"...the duty resting upon air carriers to perform their services with the highest possible degree of safety in the public interest."

US Federal Aviation Act 1958 S 601(b)

"...the prevention of any deterioration in established safety procedures ... and furtherance of the highest degree of safety in air transportation and air commerce ..."

US Federal Aviation Act 1958 S 1

"The good record of safety the airlines now enjoy results not only from five decades of experience, but, more importantly, from a sizable margin of safety over the so called required levels (the Federal Aviation Regulations), a margin which airlines in the past provided on a voluntary basis as part of their perceived public obligation"

R.R. Oray, Winthrop, Stimmson, Putnam & Roberts, 1985

" The standard set in that law is not whatever safety you can 'afford'; not safety at the margin; not the bare minimum of safety - but safety with all the caution our inventive genius can build into aircraft and the air traffic control system to assure safety."

Hon J: Oberstar, USA Congressional Committee on Public Works and Transportation

The aims of the Australian people for the regulation of aviation quite clearly have been to establish and maintain an environment in which the government and the industry are able to maintain safety:

. to risk levels implicit firstly in ICAN and later in ICAO determinations and those applying in member nations, thereby permitting Australian national aircraft to continue to operate in foreign airspace

. to risk levels acceptable to the public so that aviation continues to be used in the national interest

. while permitting the industry sufficient profitability to grow according to national needs.

When a risk is thought to be controllable by an individual's skills or habits, when it is optional, or remunerative, or an act of nature, or happening only to someone else, individuals will personally engage in the risky

behaviour, even though they do not accept the risk to society as a whole. If the risk is imposed on them by someone beyond their control, and who stands to profit from the activity, individuals are a lot more demanding.

Society seems to have reached a consensus that, when something causes a risk of death over a normal life-span between one in a million and ten in a million, government action to protect the public is desirable.[5] But, people do not personally seek to avoid something unless the risk is quite a lot higher than that. The aviation-hazard which receives least attention from the regulators falls in the middle of that range. This is the chance that, during your lifetime an aircraft will fall on you. In the USA that rate is 4.2×10^{-6} per lifetime . The individual's response to that hazard is to act as a citizen to ensure that government does its job, but not to be so concerned as to change living patterns.

Thus people will continue to use aviation even though the risk to society is higher than desirable.

Assessing the Current Risk

The public cannot see the risk, they can only see the accident record, and that does not assist them.

Despite the fact that the past accident record might be characterisable as a Poisson distribution with some constant small probability of accident, it cannot be used as a measure of the current risk. To do so would involve assuming that none of the factors which contribute to accidents has changed from its past value. The fact that we have not had an accident does not mean we are not about to have one now. Something might have changed.[6]. There are many factors which might contribute to an accident. Some can reasonably be described mathematically. Others are never to be repeated events. Accidents are truly random events. They simply cannot be predicted. The past record cannot be taken as a measure of the current risk.

Indeed the acceptable accident rate is so low that, if there have been enough accidents to provide a sample large enough to estimate the accident rate with confidence, there have been too many accidents; and that in any case, by the time one has the accident statistics it is too late. There is torn metal and blood on the ground.

A civil aviation regulator attempts to assess and then control the current risk not by reacting to accident statistics, but by attempting to nullify or moderate individually all of the sources of unreliability which might turn a hazard into an accident.

To simplify further discussion some local jargon is necessary:

Hazard

A contingent harm or injury

Unreliability

the probability that in the next unit of time a person or a thing will not behave as expected.

Standards

[5] Goldstein et al op cit

[6] If the accident rate were to change suddenly it would be reasonable to suspect that some underlying factor had changed. But how does one find a significant change. When the statistics are all rubbed together, as some safety regulators will do, important changes are buried. If one draws apart the strands to see the detail, then usually the sample size is to small for confident inference.

Many unreliable features of aircraft construction and aircraft operation have been identified, categorized, researched, and generalized where appropriate into principles, to form a body of aviation safety lore that is the basis of most of our aviation safety rules and practices. This has been going on for about one hundred years. The rules are known as "standards".

Margin of Safety

The difference between the standard and an particular example.

Association

A relationship between two events or conditions that occur more frequently together than one would expect by chance. (Stress concentrations and fatigue cracking for example.) Association does not necessarily imply a causal relationship.

Causal Association

Identifying causation begins with the recognition of an association.

Drawing causal inferences after finding an association requires the exercise of further judgement. Before declaring that some particular agent causes a condition, one ought to test whether :

Exposure to the agent precedes the condition invariably.

. The proposition does not contradict the precepts of physics, chemistry, biology etc, that is, it is scientifically plausible or explicable by known mechanisms; or there is an analogy with some other accepted causal relationship.

There is no other plausible explanation

. There is an association between the agent and the condition , that is,

the relative frequency of occurrence of the condition following exposure to the agent, is actually greater than the relative frequency of occurrence in the absence of exposure, or

some portion of the variation of the condition is attributable to variation of the agent.

. The data suggesting the association are accurate and free of bias, and the observations are statistically significant.

. In the absence of a reasonable explanation to the contrary, an increase in exposure leads to an increased probability of the condition .

. The inference is otherwise logical.

There will be more confidence in the inference if the observed association is strong and inconsistent repeatability is explained.

When the industry complains about the authority's over regulating, this is the field of battle. Is there in fact a causal association between the standard, or the proposed standard, and the unreliability, and thence a correlation with the behavior in the face of a hazard.

The authority surveys the industry continually and reports margins of safety in everything from the storage of fibre glass laminates to the making and retaining of accurate aircraft records, the control of tools, and so on.

If the margins of safety are all positive then it is reasonable to conclude that the portion of the industry surveyed is as safe as the standards intended it to be. But in general that is not the case. And no matter how the observations are worked over, they will not reveal the current level of safety unless the surveillance on every component of the industry is continuous. It only takes a moment to lower a margin of safety, but months may elapse before the discrepancy is found.

So the public remains uninformed as to whether their requirements are being met and will be dissatisfied unless it has great confidence in the regulator. Absence of the evidence of risk is not evidence of the absence of risk - but it will have to do.

Some Realities of Regulation

Safety Regulation and Commerce

The aviation industry is an important contributor to national power. Many authors have argued that this is an important influence on the aviation regulatory posture of governments. Those authors identified two styles of relationship. In the USA the prevailing philosophy was said to be one which held that regulation should ensure the private operation and competition of industry in an unfettered market, and that individual's calculations of self interest with minimal constraint were best for industry growth.

The European concept was said to contend that commerce is an instrument of national policy and required government involvement, especially to actively promote indigenous aviation industries. It was inevitable that those policies would clash internationally. There has been a profound and fundamental conflict between air transportation as a business, and air transportation as an internationally regulated industry in which the nations of the world shared equally

Airworthiness standards have not been protected from this conflict. The original Paris Convention of 1919 was beset by such troubles - American and German aeroplanes for example were excluded from the countries of the British Empire on airworthiness grounds for ten years or more. Much more recently," EROPS off the drawing board" was an issue of this nature. Commercial and national competition tended to prevent those involved from presenting their thoughts in. unbiased manner. Each manufacturer defended his own design against criticism and also tended to compare it with other manufacturers' designs to the detriment of the latter.

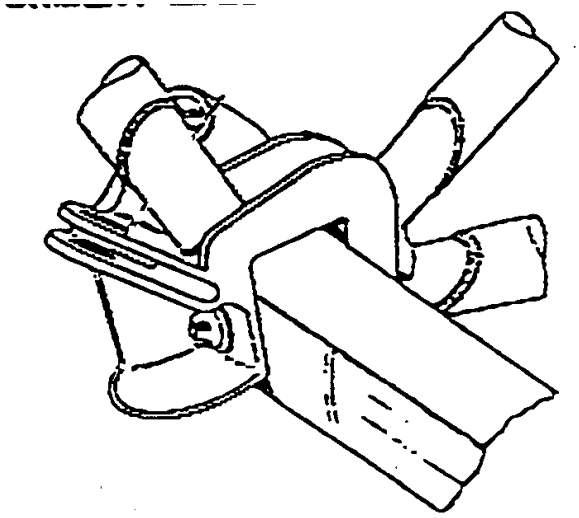
Major airworthiness authorities are affected by national pride and reluctance to see their countries' manufacturers embarrassed and financially burdened. Researchers defend statements which they happen to

have made in the early stages of international discussion, and so on. This parochial unwillingness to admit that things are not quite right infiltrates safety regulation from time to time.

Obeying the Rules

Once upon a time a helicopter like this crashed in the USA.

It crashed because cluster joint shown below cracked and broke because of fatigue. The tail boom came loose and smashed into the main rotor blades.



The manufacturer issued a Service Information Notice requiring all the joints in the structure to be inspected by eye every day and by special methods every 200 hours of operation.

The manufacturer designed some new joints which were stronger, They gave them new part numbers. One of the new joints was known as dash 3.

Because the new joints were stronger, the manufacturer believed they would not crack and so the Service Information Note exempted dash 3 joints from inspection. That is hardly ever a good thing to do.

The US Federal Aviation Administration issued an Airworthiness Directive which made inspection in accordance with the manufacturer's SIN mandatory for American helicopters. The Australian Department of Civil Aviation did the same thing for Australian helicopters, thereby exempting dash 3 joints from inspection.

Three years later, one of the strengthened joints failed in flight and another of these helicopters crashed killing the occupants.

The Australian authority reacted by making inspection in accordance with the manufacturer's SIN mandatory for all styles of joint and explicitly the dash 3 style.

Here is an extract from the Airworthiness Directive.

SCHEDULE OF AIRWORTHINESS DIRECTIVES — AIR NAVIGATION ORDERS
PART 105

HUGHES 269 SERIES HELICOPTERS — PAGE 12 - 30 September 1980

AD/HU 269/57A — TAILBOOM CENTRE ATTACH FITTING AND CENTRE FRAME AFT CLUSTER FITTING - INSPECTION

Applicable to Aircraft: All models with tailboom centre attach fitting P/N 269A2324 (including -7 fitting) and centre frame aft cluster fittings P/N 269A2234 (LH) and 269A2235 (RH) (including respective -3 fittings).

Requirement: Inspect in accordance with Hughes SIN No. 82-3.

NOTE 1: Improved fittings of -7 and -3 (respective types) designation on all models (including helicopters with S/Nos. greater than 569) are to be inspected.

NOTE 2: AD/HU 269/38A has been cancelled and superseded by this Directive.

Compliance: Step I at each daily or overnight inspection after 1 December 1976.

Step II at intervals not exceeding 200 hours time in service from

The manufacturer did not change the SIN.

On 14 Feb 1995, an Australian Hughes 269 helicopter VH-PKK crashed into the sea near Melbourne. The only person on board was killed.

VH-PKK crashed because this very same joint failed. The joint which failed was the allegedly stronger dash 3 type. When inspected by the CAA, the other dash 3 joint on the helicopter was found to be cracked.

The Licensed Aircraft Maintenance Engineer responsible for the helicopter had signed the logbook to say that he had complied with the Directive. However, he told the Coroner that he had not actually carried out the inspection required by the Airworthiness Directive - because he had been told it was not applicable to dash3 joints according to the American directive.

When faced with the Australian AD 269 /57A and the contradictory American AD, he acted irrationally and omitted the inspection, convincing himself, with the assistance of others, that the Australian AD did not require dash 3 items to be inspected.

The Coroner was told that a further five ADs which should have been complied with had been ignored for the same reason. The Coroner was also told that another dozen or so ADs had not been completed.

This helicopter was being used commercially for scenic tourist flights along the southern Victorian coast. Whose mother or son would have died if the joint had lasted just one more flight. Would the LAME have behaved in the same way if he had thought about that. Perhaps the LAME did not want to do the inspection or was unable to do it. If the LAME had genuine doubts, why did he not contact the CAA.

The ATSB in its published report wrote that the Directive was ambiguous. and thus further reinforced the notion that the CAA was incompetent. There was no ambiguity. The Directive was absolutely explicit.

On 24April 1994 Douglas DC3 VH-EDC ditched into Botany Bay following the shutting down of one engine at about 200ft AMSL after take off. On board were 21 schoolboys of an Army cadet band, and a crew of four. The flight attendant was seriously injured. The aircraft had been chartered to take the band, with its instruments, from Sydney to Norfolk Island via Lord Howe Island – a distance of more than 1400km over open water.

This was an extended range operation (EROPS) The aircraft type design was not approved for EROPS nor was VH-EDC in particular approved for EROPS. Although this did not contribute to the accident, the Regulations prohibited VH- EDC from setting out on that route.

The aeroplane should have been maintained as a Class A aeroplane. It had not been.

No Maintenance Controller had been appointed.

The aircraft logbook was all but unintelligible. Thousands of hours were missing. But, it could be seen that, over the past thousand hours or more, many maintenance requirements had not been recorded as completed. The state of the maintenance records would have justified withdrawing the aeroplane's CofA

The aeroplane was loaded beyond max allowable take off weight.

The owners and the crew of VH-EDC were told these things by CAA officers.

But the aircrew and owners acted irrationally and contracted to carry out the flight.

The aeroplane was released to service when it was far from clear that all necessary maintenance had been done.

They had modified their perception of the regulations arguing that :

AD /GEN/69 was the only regulation prohibiting DC3 EROPS and "ADS did not apply to aircrew"

Other DC3s on the Register of Australian Aircraft were Class B aeroplanes

Class B aeroplanes did not require a maintenance controller

All the maintenance had actually been done. It was just not recorded.

The RAAF had operated the DC3 at higher AUW.

Two years after the accident, BASI, now the ATSB, reported that the CAA's regulatory material was unclear. If it were in fact unclear an effective watch dog should have found the lack of clarity before the accident. AD/GEN/ 69 was not just another Directive. It was a major policy statement.

Both these cases may be looked on as simple disobedience, but was the disobedience wilful.

The Authority Rules Ok?

People in general unwittingly act in unsafe ways. People do not always appreciate the dangers of their action or inaction. It is the job of a national aviation authority to make sure *that people in the aviation industry have the knowledge and incentive to act safely*. This is most commonly done by issuing Regulations of one form or another. But, a Regulation is only the current attempt to express the functional requirement. Regulations are not holy writ.

Neither are they wholly read..

Anyone relying on regulating people by statutory Regulations will soon be disappointed. This is especially so in an activity that is so large and so dispersed geographically, so important to the national economy; and so complex. The history of civil aviation safety in Australia is mapped by instances of the flouting, avoidance, and ignorance of Regulations. From the major airlines to the smallest tourist helicopter there runs a strand of a sort of *cognitive dissonance*, which is resolved by disbelieving the Regulations.

Cognitive dissonance is the name given to a form of behaviour motivation.
When confronted by two pieces of knowledge about an important subject which contradict each other, a person may experience dissonance. He will feel uncomfortable. He will act irrationally. In argument he will resort to pontification and bluster . To resolve the dissonance he will try to modify his perception of one of the pieces of knowledge so that it no longer contradicts the other piece. For example:

Cognition: I am about to installed an un-approved alternator in my aeroplane because it is cheaper.

Dissonant Cognition: But, civil aviation regulations prohibit the installation of unapproved parts, presumably because the practice is dangerous.

Modification of Cognition: However, the regulations don't actually say its dangerous. The new alternators are made by the same people in the same factory so they are probably also approved.

Safety by Persuasion

The reality is that safety in aviation is governed by three things:

- ***Money***
- ***integrity*** **, and**
- ***knowledge*** **.**

Air safety is best maintained neither by close detailed supervision, nor by the fear of retribution, but by persuasion.

For many years, Australia's civil aviation authority bore all the hallmarks of success. It was held in high international repute for its technical excellence. Australia's safety record was second to none. It was an organisation which, as do all effective organisations, depended on officers respecting, trusting, protecting and

supporting each other. They engaged in open communication. They shared common goals and beliefs. They subordinated personal objectives to those of the team. Leadership was distributed.

Officers of the civil aviation authority were able to persuade the industry to behave in the full public interest by the weight of their personal, rather than statutory, authority. That personal authority stemmed from the evidence in hand, their experience, technical expertise, wisdom, rectitude, fair play, pragmatism, personal example and concern for the welfare of others. In other words from their qualities of leadership.

It would not go too far to propose that the good safety record was largely a consequence of the collective personal authority of the senior officers in the Department's Head Office and Regional Offices, and their ability to exercise it.

An axiom of quality-management, is that those people who are inside any process will be the first to see the problems. Be it playing football or mustering cattle, the ability to "read the situation" is invaluable. Such men and women are rightly allowed to dictate the play. So it is with aviation safety. People who can discern meaning from the signs around them are invaluable. But, if held in restraint by the uncomprehending, the unbelieving, the timid or the mediocre, they can achieve little.

The effectiveness of the Division , the Authority as it was to become, was diminished by a physical transfer of Head Office from Melbourne, by the rapid expansion of the Australian fleet, by the abandonment of the Two Airline Policy and by the subsequent extraordinary reduction in funding from the Commonwealth Government. on the advice of unqualified people with axes to grind, and by a 30% reduction in technical staff. Reinstatement of the ability to safely dispel cognitive dissonance might go a long way to rectifying the perceived ills of the present. Certainly the same effect cannot be achieved by a bureaucratic appeal to Regulations. Unfortunately, intelligent and effective regulation does not come cheaply.

But, this is not to suggest that CASA should be equipped and manned to lead a largely self- regulated industry on the path to safety. In any case, leadership, as a means of attaining an aim, depends entirely on the leader and the led having objectives in common. When push comes to shove, and it does so frequently, *the objectives of the industry and the Authority are not the same.*

Fairly clearly the CASA would benefit from a group of highly skilled, very experienced people either on staff or on retainer to act as national resource specialists.

The Recreant Regulator.

Another reality of regulating, is that sooner or later, the regulator will be alleged to have caused an accident,. or at least contributed to the cause. A civil aviation authority itself runs risks in the course of performing its duty to the public. – a duty that arises from the public's having given the authority its trust. No professional officer of the authority forgets this duty. Others sometimes do.

These risks are always present and accepted as a matter of course. They come to light when an operator's legal council seeks to shift culpability for an accident from the operator to the authority. But, more often, the quality of the authority's performance of its duty to the public will be publicly questioned by journalists armed at best with a half truth and motivated by caviling participants in the industry.

The authority will have or will be alleged to have, made an error, been negligent, covered up or withheld information, failed to promulgate instructions, not investigated defects and otherwise acted unsafely; or been unduly harsh or rigorous.

If the top management of the authority is not sufficiently knowledgeable, or is unwilling, to debate the matter, Australian experience has shown there is a real likelihood that the operations of the authority will be curtailed, and that unsafe situations will develop.

The Relative Roles of Standards and Good Judgement

Safety is achieved by a balanced combination of the authority's activities. Where for example there has been a less than fully convincing demonstration of compliance with entry standards, higher standards of maintenance or monitoring in service can be required. Where a standard for entry is known to be more stringent than necessary, considering the lives and assets at risk, lesser standards of compliance demonstration can be accepted. The necessary balance is achieved by the good judgment of the regulator's officers rather than through the formal specification of detail in promulgated standards and procedures. That is a practical and satisfactory approach.

The regulator's errors will be human errors and, before going further, the concept of risk or probability in the context of human error should be considered. Probability is "relative frequency in the long run" - the proportion of identical situations which will give exactly the same result. No two humans are identical. Nor are the conditions which they experience constant over time. Probability is not a concept that can be usefully applied to human error in other than the most circumscribed situations. We must substitute a subjective assessment, or opinion, as to the risk of error, without numerical values. The important thing is to know when the risk of error is high and when it is normal.

The regulator's standards are expressed in civil aviation regulations and other subordinate legislation and advice. Ultimately, a regulation or instruction is only the best contemporary expression of the general intention at the time. Sometimes the expression will not be sufficiently precise or the intention adequate.

In setting standards, one can only hope to cover most eventualities. To attempt to do more leads to rules that are so general and so abstract as to be impracticable. But, the end result is continuing reliance on the judgement of regulator officers to interpret and apply the spirit of the rules. It seems to be very easy in a court room to discredit the application of judgement by a minor bureaucrat - even when the judgement is not faulty.

Furthermore, pressure is regularly applied by influential segments of the industry to interpret regulations in a liberal way or to set standards aside, usually only for a short period, but from time to time permanently aside. This is almost invariably for the administrative convenience or the commercial benefit of the particular participants in the industry. The pressure often falls on relatively junior officers and is very difficult to resist.

Ultimately, the CASA is a body corporate, but when it comes to errors and omissions the authority is a collection of individuals each of whom is fair game and is treated as such by politicians, senior management, and legal counsel.

The very existence of written standards is itself another potential source of trouble. Compliance with a standard is an accepted defence in product liability actions. Each accident, caused by poor aircraft performance, premature component failure or maintenance error, and in which there is a question of liability, will lead to examination of the facts of compliance - to the Authority's checking of compliance and to the adequacy of the standard we have set. Blind, doctrinaire adoption of foreign standards and foreign compliance checking is unlikely to be defensible; nor is the adoption of standards by virtue of their being advocated by the industry.

There has been an understanding that the courts will not expect a professional, in exercising judgement, to demonstrate any more skill than an average member of the profession would possess. However, there are questions as to whether as a regulator a person may be expected to demonstrate higher standards of skill and foresight, and whether the courts' expectation has been supplanted by a new criterion.

The authority should be concerned that any alleged lack of diligence might be dealt with by administrative rather than judicial process. The administrative process is politically driven and too likely to be swayed by professed outrage at the recreancy[7] of the regulator.

"An essential part of professional life should be the communication to senior management of potentially dangerous situations within their area of responsibility, and the assurance of such communication by documentation. Officers must ensure that they are in a position to demonstrate that professional responsibility has been fully discharged and that everything has been done by way of advice to bring matters to the notice of senior management, and to remove or reduce the danger if it is within the power of the professional to do so. Strict adherence to this procedure is even more important in all too familiar situations of insufficient funding and or insufficient staffing. On occasions it may not be possible for the professional to identify particular risks, because there is insufficient funding or staff. In such cases management should be advised that the inadequacies themselves create a generalized risk." [8]

Most of the factors which expose the regulator to risk are related to the propensity for human error. Independent checking is necessary to control those errors which no one will detect after they get into the aeroplane, and those which, even if found, cannot be rectified. *There is a need to ensure that errors are reported and openly discussed.*

To avoid unreasonable actions being taken against the regulator, the attitude of airworthiness and operations officers to managing the risk must be understood, not only within the regulator or the industry, but within the community at large. The officers are risk conscious, with a high sense of duty, but they do reach an accommodation with reality.

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[7] "Recreancy" being defined as the characteristic describing an organization that has been entrusted by society with special responsibility and authority, but has carried out the activity in ways that misuse the authority or do not merit the trust.

[8] Legal Liability Advice for Professional Engineers, Smith D.J, for APESMA Sep 1989

To remain effective, it is necessary that any regulator strike a balance between irresponsibility and excessive intervention. This is in fact a community expectation. The concern must be that, as we have seen abroad, the courts will not apply community norms but will enforce the most unreasonable letter of the law. If that proves to be so, it is inevitable that as an effective regulator the Authority will be vulnerable.

The administration of aviation safety regulation, by virtue of its complexity and the small engineering margins necessary can easily become a high risk occupation. Of necessity, the regulator's control action must be indirect and anticipatory, rather than direct and reactive. It can only be done well by highly qualified and experienced people who thoroughly understand the principles and the environment.

There is very good reason to believe that the public acceptability of accidents is strongly dependent upon the faith the public has in the competence of the regulatory authority. With a seemingly competent authority, any accident is seen as an unfortunate inevitability - an act of God.

Investigation.

The Relevance of Accident Investigation

Knowing the causes of aircraft accidents has been a most important and useful tool in identifying the sources of risk a regulator must control. A single accident caused by a particular feature in any process or in an aircraft type is usually sufficient to label the feature as unacceptable or requiring special control.

On the other hand, the requisite level of safety is so high that it is now impracticable to use the absence of accidents caused by a particular feature as a demonstration of the reliability of that feature - unless that feature has been replicated in many aircraft types.

People have a remarkable penchant for explaining away failures and errors - especially "human errors". And we always see perfectly in retrospect. When the actual outcome is known, the various alternatives take on quite a different plausibility than they had when presented beforehand. It is a lot easier to determine what is obvious after it has happened. Moreover everybody's short sighted interest is satisfied by proving that an accident was an isolated incident unlikely to be repeated. Indeed the accident investigator encourages the process by going to a great deal of trouble to establish exactly the specific unique circumstances of each accident. Little wonder then that a single accident is frequently not interpreted as a precursor of problems fleetwide.

Accidents are very infrequent events - they are most unlikely to happen. Ipso facto they are caused by most unlikely events or by most unlikely combinations of rather more likely events. It is most unreasonable to dismiss an event as the possible cause of accident simply because the event would be unlikely to happen.

That said, it is something of a folly to argue over the absolutes of what "caused" an aircraft accident. It is more useful to identify reduced margins of safety that have a causal association with the accident, and why they were reduced. The final objective being to *identify what must be prevented from happening in the future*.

Investigation of Major Defects

Accidents produce only a very small proportion of the information which an authority receives about reduced margins of safety. Very many potential problems were discovered by an alert maintenance crew before they

troubled the flight crew at all.[9] Most of those defects had nevertheless caused the aircraft to operate at higher than normal risk for some time before their discovery. In Australia, the law requires that these defects be reported to the regulatory authority. the manufacturer and the State of Design. The next step is to investigate the defect and devise airworthiness control action.

It is not sufficient for Australia to rely entirely on the regulatory action of the State of Design. Experience has shown that, frequently enough to cause concern, such actions are deficient, inefficient or inappropriate.

Usually the identification and diagnosis underlying a State of Design AD can be accepted without question. However, there are also occasions when it is quite clear that the identification or diagnosis of the problem by the manufacturer or the foreign airworthiness authority is so obviously at variance with Australian knowledge that it must be questioned. These matters are questioned most carefully when there has been an accident associated with the defect.

Instances which serve as most easily remembered examples involve:

the Boeing 747 explosive decompression and collision with Mt Ogura

DC9 rear pressure bulkhead attach angle cracking

the Aloha B737 explosive decompression

an engine disintegration and fire on take off in an Australian Boeing 727,

a fatal accident caused by failure of the main rotor-blade grip in a Bell 47 helicopter, and

a fatal accident involving failure of the tail boom of a Hughes 269 helicopter.

a fatal accident to Puma helicopter VH-WOA caused by a tail rotor fatigue failure

To illustrate further; Australia's small part in exposing uncertainties about the B737 in the months before the Aloha accident are now almost common knowledge. What is not so commonly known is that Australia contributed similarly to controlling a much more serious problem with fuselage Section 41 of the B747. Australia issued an AD on this subject. The USA followed some months later. Qantas B747 were found to be badly damaged at times in service shorter than those in the country of origin proposals. Eventually, B747s in USA and UK were also found to be damaged after shorter times in service.

There is a long history of that sort of episode. This is especially related to structural fatigue - one of the greatest killers of passengers in aviation history.

The control action described in a country of origin Airworthiness Directive is intended only for application within the country of origin. Frequently this action differs from the action recommended by the manufacturers and often this variation arises from differences in motivation and responsibilities.

The country of origin control action will be consistent with the interests of that country and the legislative restrictions applying in that country. The airworthiness authorities of some countries are not permitted to

[9] As an indication of the numbers of different serious defects that occur, consider that during a typical year, aircraft manufacturers issue about 13,000 service bulletins recommending correction of airworthiness problems. The airworthiness authorities of the manufacturing countries issue about 450 "country of origin" Airworthiness Directives to correct the urgent safety problems.

anticipate problems. Other authorities are occasionally influenced by the commercial interests of the local manufacturer. Engineers at the working levels in the CAA, the FAA, and other regulatory authorities once discussed these matters freely.

Difficulties of these sorts started for Australia with the DH86 and have been experienced with aircraft as diverse as B747, BAe146, Robinson R22, and Hughes 269.

Implementing the required control action for the Australian fleet was for many years the responsibility of the Australian airworthiness authority, and there are very good reasons why the CASA should devise that control action itself. In the past the major aviation countries of the world have taken the same stance. There is a mix of reasons for this stance. The mix varies between countries but will include the foreign equivalent of the following reasons.

The control action devised for the country of origin may not be suitable for Australian conditions, where we have:

. a different range of aircraft and a vastly different range of uses for given aircraft types

. different maintenance capabilities and geographic dispersion of maintenance facilities

. the ability to be more responsive to individuals in the industry, and

. Australian operators and maintainers who are quite remote from the aircraft manufacturers

. regional Australia's economic dependence on light twin engined aircraft

The author of an AD in Australia is expected where practical, to consider the commercial consequences of the Directive. The State of Design can hardly be expected to review the commercial consequences that an AD would have in Australia.

The foreign control action may be inappropriate because the requirements are unintelligible.

They may be inappropriate because there have been Australian Directives controlling the same subject for some considerable time. Such is the case with the control of fatigue and corrosion in the AeroCommander range of aeroplanes. It was also true with the Douglas DC3 and remains so with an extensive range of other Transport Category and General Aviation aircraft.

The potential for conflict between foreign ADs and extant Australian ADs will continue while ever it is likely that the Australian CAA has reacted or continues to react more quickly to safety problems than other countries react. This conflict is likely to prejudice safety.

The State of Design's control action may be expensive and unnecessary. Examples are not too hard to find. They include component retirement when safety can be maintained by inspection, and compulsory modifications or inspections that are ineffective. In 1996 the FAA issued an AD requiring certain AeroCommander aircraft to undergo a rather expensive inspection for cracking at Wing Station 39. In the view of the Australian authority, the inspections were called for at a time in service that was far too early for cracks to be detectable. CASA did not promulgate the AD. In the USA, 161 aircraft were inspected (322 inspections) and not one crack was found, despite the cracking being a real problem. The FAA's future control action has

been somewhat compromised by that affair. There have been similar experiences with, among others, Bell 47 main rotor blade grips, Piper Cherokee wings and Rockwell 114 wing spars

The State of Design's control action may be unsafe. There may in fact be no control action. One time inspections for problems caused by fatigue are a case in point. It may specify maintaining safety by inspection when it has not really been established where to look, when to look or how to look, and that there really is time to look.

The control action may be based on the proposition that defects have not occurred - when in fact no one in the country of origin has even looked for them.

Too often it is assumed that what we will see in the future is no different from what we have seen in the past. With ageing and wear out that assumption is clearly a fallacy.

Several aspects of Australian environmental conditions are significantly more severe than experienced elsewhere. There seems to be a higher incidence of freezing rain that has extinguished gas turbine engines in airliners. Temperatures at altitude in the tropics are much lower than the ICAN standard. This has also lead to multi engined flameouts in at least one type of gas turbine powered airliner.

Diurnal temperature variation and ground flight ground temperature variations are sufficient to initiate thermal fatigue in carbon fibre epoxy composite primary structure - such as the tailplane of the Airbus A320. Similar humidity variation causes crazing and cracking of transparencies.

The atmospheric gust spectrum is particularly severe in Australia. This does not only shorten fatigue lives. Australia is one of the very few places where the wings have been torn from a modern airliner by atmospheric gusts. Aircraft in Australia are often used intensively in roles which the designer never intended and for which they are not so used in the State of Design - stock mustering for example. The manoeuvre load spectrum is correspondingly more damaging. There is a similar problem with runway roughness. These conditions increase the chance of structural failure between inspections, and inspection intervals should be shortened accordingly.

A very large portion of Australia is formally declared remote area, and Australia must be one of the very few countries of the world with ETOPS conditions applying on main trunk routes over land.

Historically, aircraft in Australia have a significantly higher utilisation rate than those overseas. In other words, there has been a trend for Australia to have the "oldest" aircraft in the world. (Wide bodied airliners on short haul routes are a noteworthy exception.)

These factors ought to be part of the technical consideration leading to an AD. However, they are generally not considered by a State of Design AD prepared overseas.

The concept of the null AD is very real but rarely recognised. In the face of an airworthiness problem, the decision not to issue an AD is every bit as important as the decision to issue an AD.

There are numerous reasons why a State of Design would decide not to issue an AD when an existing airworthiness problem would otherwise demand one. The most common has been that the problem has not yet been found in the State of Design. However, it is an unfortunate fact that, because the State of Design is usually the State of Manufacture, it is the State with the greatest commercial incentive not to issue an AD. Example after example has troubled officers of the Australian Authority for many years.

Requiring that, in the first instance, Australia adopt the technical assessment of the State of Design markedly increases CASA's susceptibility to pressure from the industry not to issue an AD.

Directly or indirectly hindering or preventing CASA from issuing an AD could be quite unsafe.

In short, experience has clearly demonstrated that there are severe safety risks in depending on foreign authorities for airworthiness control in Australia.

When the chips are down, operators have no commitment to their competitors or to the remainder of the industry, and indeed no incentive to thoroughly investigate defects - though some are much better than others. The final investigation of a defect almost invariably disadvantages the operator who first reported it. Some operators have gone to quite unusual lengths in delaying the investigation of defects. Any sense of social responsibility is easily over-ridden by commercial pressure (and sometimes by a desire to conceal earlier bad practices from the CAA.)

It is a matter of record also that manufacturers have been most reluctant to acknowledge that defects occurring in Australia are pervasive design or manufacturing faults - even when the evidence is squarely before them. Some manufacturers seem unrepentantly predisposed toward "proving" that any defect is an isolated incident probably caused by local operating conditions or by the ineptitude of the local industry. There are still fresh memories of a manufacturer considering bringing manslaughter charges against an Australian aircraft maintenance engineer for an accident that was unquestionably caused by a manufacturing defect overseas.

There must be a method of ensuring that the airworthiness control aspects of defects in Australian aircraft are speedily and independently determined by an expert, commercially disinterested, agency, which is primarily concerned with the safety of the whole national fleet, and which has authority to take action.

This function is most appropriately performed by CASA, and the manufacturer, in consultation with the operator. This ensures that:

Similar aircraft in Australia are not left at risk.

The manufacturer and the operator do not come to an arrangement that gives preference to continuing operation rather than to public safety, while camouflaging the manufacturer's liability, and

Both specific and more general airworthiness legislation is reviewed for adequacy in the face the particular defect and similar classes of defect.

The Evolution of Airworthiness Standards

Aviation is characterised by conforming from square one with highly technical legislation and codes of practice and day to day safety directives collectively called standards.[10]

[10] In the trade, the term "standard" is more usually confined to legislated requirements - eg "design standards"

Inertia and Resistance

Standards evolve from experience - accidents, incidents, close calls, errors and defects which become known to the regulators. There is as yet no method of categorising or compiling this experience that taps the superior powers of association and correlation of the trained mind. Accordingly the experience is stored in the "corporate memory". Unfortunately the corporate memory fades. The inexperienced are incredulous, and many lessons must be learned again. "Experience is a very bad teacher. First you get the examination then you get the lesson."

Under normal circumstances, the documentation of the experience as new safety legislation is a slow and painful business.

Achieving unanimity can be very expensive and the public as a whole defers to the regulator. But politicians, lawyers, bureaucrats, manufacturers, maintainers and operators all get involved. The process has all the characteristics of commercial negotiation over major development planning.

Participants look to protect themselves and their existing programmes. Some seek authority, some strive for the high moral ground, some seek to avoid work, some seek to avoid responsibility. Popular middle ground initiatives are favoured, sometimes without analysis, and sometimes facts are suppressed. Coalitions are formed and pressures are applied.

Government agencies become locked in by the impact of prior choices. Procedural rigidity prevents adjustments in response to new knowledge and technology. Poor bureaucratic structures and processes render authorities less competent and less responsive than they should be. Complacency can easily arise - from unfounded reputations for conservative and safety conscious design and manufacture, and from erroneous perceptions that aviation is inherently safe. Unwillingness to admit an error of judgement is a common trait in the authoritarian organisation. Complacency, cognitive dissonance, appeals to the catch cry "if it works don't fix it", all serve to thwart response to information that demands attention.

The result is stifling inertia and resistance. The books by Ralph Nader and John Nance and Mary Schiavo were written eleven years apart - yet they are each describing the same continuing problem. Crises may be necessary catalysts for change.

The Crisis Theory of Evolution

The regulatory authorities speak of "standards development" but in truth it is more a sporadic evolutionary process rather than one of conscious development. Despite the best intentions, they produce higher complexity and increasing differentiation of parts or functions through specialisation in ad hoc responses to the environment.

In the past it has been convenient to say that standards are changed when either they have fallen behind technical developments in the industry, or the service experience differs from the safety level originally intended. More truthfully, standards are under continuous review by those people who are using them daily and who amend interpretations in an ad hoc way to suit the technical changes facing them; and who make daily judgements on the rigour to be demanded in demonstrating compliance. Until recently at least, the institutional policies have followed the path of all such policies. Once a policy has been adopted, it is pursued until a crisis demonstrates that it is no longer feasible.

Safety engineers have all seen the knee jerk reaction to an accident that, in response to a perceived crisis, introduces an inappropriate modification or inspection. Some are trivial some draconian. On the other hand it takes years for the results of common engineering knowledge to find their way into design and maintenance standards. That remark is not intended to suggest that aviation safety regulators have been blameworthy in this respect. The process is driven by societal, financial, and political forces.

It is one thing to design with a particular intent. It is another thing to demonstrate that the intent has been reliably achieved. It was quite another altogether to tacitly accept that cabin depressurisation in flight was not a major hazard.

In 1985, 1988 and 1989 there were three accidents which killed 534 people and injured sixty or more. Against a four year long background of difficulties with the pressure cabin of the Boeing 747, it was the startling photographs of the "Miracle 737" carrying US citizens which dramatised the situation. It drew sufficient attention to the run of in-flight depressurisations that the matter became politicised and crisis-like. In the flurry of activity that followed, there was a dramatic adoption of a policy to inspect pressurised structure for cracks and to eventually replace aging material rather than to continue inspections. A great deal of additional soul searching followed, and elaborate plans were made for finding and fixing problems in the fleet.

Contrast that with the helicopter and light aeroplane situation in which regulators have also for many years known of the susceptibility to fatigue problems, but, in the absence of a crisis, have had a great deal of trouble implementing effective design standards. We could speculate on what the crisis reaction might be if workers from off-shore platforms in the North Sea, the Gulf of Mexico, the South China Sea or the Australian North West Shelf, were to refuse to ride in helicopters because of their perception of the accident record.

One accident alone is not enough to create a crisis reaction. People have a remarkable penchant for explaining away failures and errors.

Safety First ?

The directive from government to a safety regulator is inevitably that safety must be maintained or enhanced. So for example, when a new design or design standard is proposed, the resultant level of safety must be demonstrably as good as or better than the currently promulgated minimum standard, and ought to be at least as good as any higher standard we have become accustomed to. Airworthiness authorities are not expected to argue safety standards from a zero base. Detailed quantitative defence of the existing standard is not regarded as necessary.

At least that is the principle that has applied for the last sixty years or so. However, maintaining an effective safety regimen is becoming increasingly difficult. There have been increasing political, financial, and economic pressures to minimise costs, to introduce attractive new technology, to deliver aircraft and passengers on time, and to meet personal guarantees.

In Australia things have altered as a result. Standards have in fact been relaxed under the combined pressure from groups who could not meet the standards, those who wish to be free to set their own maintenance costs, those who resent being regulated at all, and those who would profit from selling or using cheap aircraft. The effect is most obvious in standards for private aeroplanes and helicopters, but extended into the business/commuter class of aeroplane. The least safe components of standards applied elsewhere are said to be good enough for Australia. Australian legislation was changed to prevent the CAA from applying special conditions to the certification of an aircraft type unless the same condition has already been applied else where in the world. Above all, the burden of proof was shifted. Those who wished to have the standard relaxed were no longer required to prove their case. Instead, those who opposed the relaxation are being required to justify the existing standard a priori. The Australian Government declared that, while safety standards must be maintained, it did not intend to continue funding aviation safety regulation, and the Parliament refused to allow safety regulation to be funded by cross subsidy. The push toward ever safer standards is not irreversible.

Proxies, Hidden Margins and Analogies

A design standard expresses a minimum quality objective for a product. It is expressed in terms of physical attributes or behaviour that can be measured, or reasonably estimated, before the product enters service. Airworthiness design standards deal with the probability that an item will fail in flight; with the probability that

other mechanisms will continue to operate in the presence of that failure; and with the variability of those probabilities over time, and in the face of imperfect maintenance. It is possible to express design goals in terms of the requisite reliability and durability. But, because we cannot measure those parameters in a prototype aeroplane, so as to demonstrate compliance with the standard, it is more generally useful to express our requirements indirectly rather than in terms of the actual performance required. Thus we specify certain physical forms, and use proxies for reality such as nominal limit load cases, design dive speeds, ultimate load factors, and arbitrary control displacements.

Each proxy is a substitute for a number of potentially hazardous situations and has been chosen or shown by service to establish an adequate margin of safety in very nearly all situations experienced - even though those situations may not have been actually identified. Because the individual situations are not individually described in the standard, the proxies are said to provide hidden margins of safety.

Meeting the proxy requirement may not always be sufficient because additional, previously unanticipated, potentially hazardous situations may have been introduced by a new design. Equally, it is not always satisfactory to propose that a design is sound on the basis that a particular design case will never arise. To do so when the design case is a proxy for reality will erode the hidden margins of safety.

The airworthiness authorities share a concern about the erosion of hidden margins. Once these reductions in margins are accepted, and even though it is known that the risks will increase, it will never be possible to demonstrate statistically in a time frame useful for airworthiness control, that the risk has actually increased. The higher risk then becomes the norm from which to extrapolate in the next equivalent safety argument for further progressive erosion of margins. The problem is compounded by the limited ability of the airworthiness authorities to critically examine the design process, so that the standard can be adjusted to suit, and by the tendency of the proving process to be dangerous.

In the past then, regulators have found it necessary and sufficient to rely on proven traditional methods of specifying requirements in the absence of rational practicable analytical alternatives. There is now a tendency toward using the literal meaning of the current regulations as absolute statements of the required level of safety. Not all such proposals are unreasonable, but some lose sight of the three points. The design standards are only a proxy for reality, there are hidden margins which should not be removed lightly, and the present standard may be wrong.

Day by day, in an economy based on competition, the aviation industry is driven by the need to do new things and especially to cut costs in new ways. There is a continual demand upon regulators to make rulings on each new twist. For some reason this all has to be done in a hurry.

Consider then the customer who puts the argument "This is permitted in case A, why can't it be permitted in my case B." The regulator who does not wish to grant the permission, because it would be unsafe, must then explain -

- case A may not have been a precedent at all
- case A may have been an error or barely acceptable, or may now be seen to be unacceptable
- the regulation is only a proxy for the real safety requirement
- there may have been compensating safety factors in the first case, et cetera.

The officer was not involved in and has no time to research the precedent which may be fifteen years old and now undocumented. Not wishing to appear capricious or arbitrary the officer grants the permission. Alternatively, the senior manager, to whom the customer inevitably appeals anyway, who has even less

knowledge of the precedent and less desire for the regulator to be unpopular, grants the permission. This is standard setting by analogy, and it always works to ratchet standards downwards.

The administration of airworthiness standards requires people with specialist knowledge, and considerable experience and intellect.

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Cost Benefit Analysis of Aviation Safety Regulation

One of the more common cries from the industry, and from other arms of government, is that all proposed aviation safety regulation should be subjected to cost-benefit analysis before promulgation. The proposal has some superficial intellectual appeal, especially to those who dislike trusting technocrats.[11]

In the aftermath of each successive aviation catastrophe, however, the public cry has been that such a concept is outrageous. "You must not put a value on human life!"

Both opinions are most often expressed extempore or off-hand of course, and with little appreciation of just what is being said.

Very occasionally the proposal to insist on cost-benefit analysis is made with malice afore-thought; because, as it will become clear shortly, CBA will lead to the delay and rejection of otherwise justifiable safety improvements.

From the viewpoint of the regulator the truth lies in the detail. But first we should examine the principles.

The Relevance of Economic Criteria

Aviation safety regulation is not only about costs and benefits to Australian society., It is also very much about the distribution of costs and benefits within society - most usually the short term cost to operators versus the long term benefit to the public.

These are questions of social desirability and that is not the province of economics. Economic criteria cannot indicate whether a change is socially desirable or not. Where, for example, are the cost benefit analyses supporting Australia's stance on preventing mining in Antarctica, and on the prohibition of whaling.

Economics is not an objective science. Value judgements enter economics in a variety of ways and they do so in a systematic and generally socially biased manner. The whole of orthodox economics takes the distribution of wealth to be fixed as it exists at the time. There is an emphasis on entrepreneurial behaviour, competition, and equilibrium which many see as being of little relevance in an economy dominated by large corporations, collusive behaviour, and tendencies to cumulative disequilibrium.

Economic criteria are not appropriate criteria for making judgements on the distribution of costs and benefits. For that reason economic criteria are not appropriate for evaluating air safety regulation.

Appropriateness of Cost Benefit Analysis

Neither are the economists' techniques of analysis appropriate for evaluating air safety regulation.

[11] A proposition with similar appeal is that the content of all proposed aviation safety legislation should be the subject of industry consultation before promulgation.

Cost benefit analysis is not a means of determining whether the benefits to society exceed the costs. It is a method of comparing alternative ways of reaching the same, presumably socially desirable, objective.

Prima facie, the notion that a proposed regulation should demonstrably convey benefits exceeding its costs is attractive. However, that is not the function of "cost benefit analysis" as now understood and practised. Because of the difficulty of absolutely measuring costs and benefits, the function of CB analysis is to choose the "best" from among competing alternatives. These are usually the null or do nothing alternative, and a hypothetical investment of capital cost at x% representing the average of all other possible projects - none of which is necessarily socially desirable.

A concept entrenched in cost-benefit analysis is discounting in an attempt to match the money/time preferences of society. Costs and benefits which arise in the future are held to be less valuable. In airworthiness regulation it is more than difficult to justify this discounting.

The whole concept of discounting future costs and benefits is quite inimical to the precepts of continuing airworthiness. At the discount rates being used, events occurring more than twenty years from now are effectively regarded as inconsequential, whereas the whole nature of design and maintenance standards is that they address events which are expected to occur twenty years after their implementation.

If, in the 1970s, the proposal that aircraft design be modified to prevent accidents being caused by fatigue had been subjected to cost benefit analysis, it would not have survived. In the 1990s, when the benefits are perceived to be imminent, the modifications are regarded as not just de rigueur, but socially essential, and justifiable by CBA. Unfortunately, the economic cost to society is now much larger than it would have been had we started twenty years ago.

Next it should be recognised that in most airworthiness regulatory proposals, the costs will definitely be incurred but the benefits may never be realised because the accident risk is so very small.

Qualitatively this is no different from most other public investment. The notion of potential benefits is firmly part of economic doctrine, and the chance of the benefits not being realised is seldom addressed quantitatively. But this is just the action that is being proposed for aviation safety regulation.

Should the chance of there being no benefit be treated quantitatively in aviation safety, simply because data seems to be available, and the chance seems to be higher than elsewhere?

A suitable test of the appropriateness of CBA in airworthiness regulation would be to ask whether it should be applied to the question of regulating the installation of Australian-made bogus parts in Australian aeroplanes.

Cost benefit analysis is a technique about which many engineers and other policy makers are wary. This is not because of any fundamental failings of the principles of CBA but a result of what seems to be an almost inevitable misapplication of the principles.

This caution is chiefly associated with use of the technique for mechanistic project appraisal, supplanting the good judgement, expertise and acumen of experienced managers.

There seem to be two underlying reasons for the caution:

- the difficulty of doing a correct analysis for a public, as distinct from private, enterprise, and
- the number of instances in which internally inconsistent or insufficiently comprehensive analyses are presented to decision makers.

The results of a CBA quickly gain an unwarranted authority of their own, regardless of proviso and qualification in the analysis itself.

This is largely because they are a simple numerical expression of a "solution" to a particularly complex problem - a straw available for grasping.

While some of the fundamental elements of CBA are philosophically shaky, others are difficult to quantify. Of these, the results of CBA are particularly sensitive to.

- selection of analysis period (ie time frame)
- the treatment of depreciation and obsolescence and maintenance and replacement
- attribution of joint and common costs
- assignment of values to unit costs, shadow prices, and demand elasticities.

The net economic benefit is often near zero and one is then dealing with small differences between large numbers - a notoriously inaccurate practice.

The principal stumbling block in cost-benefit analysis appears to be failure to explicitly define and consistently treat "the cost and benefit of what to whom".

It is not right to say simply that the costs of safety are met by industry and the benefits accrue to the travelling public. There are internal transfer mechanisms at work such as fares and freight rates and insurance.

Accordingly for CBA on aviation safety, and this is true of any public enterprise, one requires a full accounting of the resource costs and benefits to Australia as a whole. This is seldom possible for projects dealing with tangibles. It is all but impossible for projects dealing with "public goods" or "merit goods", for which no market exists - eg clean air and aviation safety.

Of course, in cases commonly encountered, it is simply not practicable to analyse the effect on the whole of society and a border must be drawn to define the system within which the effects of executing the project are said to be confined. Would it be necessary, for example, to consider the probabilities that the costs of operating light houses will take particular values if the installation of life rafts is made mandatory in general aviation aircraft.

The discounting of future costs and benefits is a particular reason why it is almost impossible to put CBA into practice genuinely in safety regulation.

The decision which might be made following cost benefit analysis, is, because of discounting, very sensitive to the timing of the proposed implementation. The newness of aircraft in the fleet which might be lost to accident, and thus their replacement-value, is one source of variation. Another source is the proximity of a fleet replacement program, the cost of which might be different with new regulations. Thus a regulation which is beneficial if started now might be a disbenefit if delayed five years. Would such a regulation be rescinded after five years? Assuming a continuous stream of aircraft disposal and replacement as is sometimes done, will not make the real evaluation problem vanish.

This exposes an area of more general concern. The stream of discounted costs and benefits arising from a particular regulation will vary from country to country and in particular will be different in Australia from either the USA or the UK. Application of CB analysis could well result in a proliferation of exemption clauses for various foreign design requirements. It would almost certainly be detrimental to the unification and standardisation of airworthiness requirements now being widely advocated.

Would CBA be applied to Australia's adoption of changes to design rules proposed by the Europeans or Americans in the future?

CBA in the Presence of Uncertainty

CBA becomes extraordinarily complex if the future is regarded as being anything other than completely determined. If there is any uncertainty (or probabilistic occurrence) of future benefits or disbenefits then the project must be evaluated on the basis of probable nett present value - a formidable task. This is just the case, of course, when considering the future costs of not making a particular airworthiness regulation.

The benefit from safety expenditure is a reduction in risk. But it is especially difficult to assign a dollar value to risk reduction. The simplistic alternative is to give it a value equal to the expected cost of the accidents avoided.

The analyst then must choose some value for the likely number of accidents which would be caused in the future by the hazard being analysed.

The analyst may chose, for example, to use historical data. That would be a dubious practice since the traffic volume, the operating environment, the number of passengers per aircraft and the aircraft design standards over the next 30 years will be quite different from those of the past.

The analyst may chose to use an accident rate reflecting total world experience. This too is a dubious practice since it can fairly be claimed that Australian operations are a different population. [12]

If Australian historical data were to be used to calculate an Australian major airline accident rate, the result would forecast zero accidents in Australia in the foreseeable future. CB analysis on this basis would be trivial as the forecast benefits would be zero.

The fact that the use of Australian accident data gives an odd result is no excuse for using completely inappropriate data like overseas accident rates.

There is a real danger of inadvertently taking the stance *"We have never had any accidents and there is therefore no need to take new precautions to prevent them or reduce their effects"*

If the Australian commuter fleet is as safe as we think it is (we have no way of knowing) then a-priori we might expect at least one Seaview or Monarch accident every million fleet hours. At 320000 hrs/year, that is at least 10 accidents in 30 years. But these need not occur at even intervals of 3 years. It is equally likely that they will occur on successive days of the first year or on the last ten days of the 30th year. The discounted value of the accidents will change by a factor of about 20 depending upon when they are postulated to occur.

In none of this is it reasonable to use some average value. To do so means that there is less than a 50% chance of getting the right answer.

To illustrate the magnitude of the problem, in 1986 the author attempted CBA on the proposal to require fire blocking of seats in Australian airline aircraft. The analysis used a range of equally likely values for the major cost and benefit parameters in the study. The estimated net benefit had present values ranging from $2000m to minus $6m depending on the parameter values - all of which were equally likely.

If in any way lacking in accuracy or rigour, CBA can be most misleading. Further, as in most forms of specialist analysis, inaccuracy and loss of rigour are particularly difficult to detect. A great deal of expertise is

[12] It would be legitimate of course to use statistics for survivability in worldwide accidents to types operated in Australia for calculating the chances of survival, given that an accident has already happened.

required to do the job properly - expertise in both CBA and airworthiness control. Without this, errors arising from poor understanding and explanation of fundamental background seem to be an unavoidable characteristic of this class of analysis.

Consultants engaged by the Department of Aviation in 1985 to examine CBA in air safety regulation presented a well-reasoned discussion of the theory of economic analysis and in the first instance addressed some of the objections raised here. Like most orthodox economics texts they went on to ignore all the caveats in propounding the application of cost benefit analysis. The treatment of CB analysis itself was similarly cavalier. Much of the theoretical and philosophical objections and difficulties were discussed, then ignored. This trait persisted into the worked examples which were simple mechanistic cost benefit analyses. It seems inevitable that future evaluations would be done the same way. This is because the analysis is fundamentally impracticable.

Conclusion

Cost-benefit analysis is neither appropriate nor practicable in aviation safety regulation. The resulting bald and mainly hypothetical cost-benefit arithmetic, divorced from discussion of the issues essential to the political decision to regulate or not to regulate is of no value.

If the views of journalists, senior public servants such as Mary Schiavo, Inspector General of the US Department of Transport, judges and lawyers represent those of the public, the public does not seem to care for the cost-benefit concept. Public cost, private benefit.

Appendix B
to Why We Regulate the
Way we Regulate and Who Pays

Some History Of
Australian Civil Aviation Safety Regulation 1919 – 1961

It will be valuable to recount the way in which air safety regulation evolved legally and technically in Australia, and to thereby open a window onto the motives and competence of the people and organisations involved.

In The Beginning

Some Preliminaries

Two of Australia's most eminent aviation pioneers were responsible for the first attempt to regularise aviation in Australia. In the Hotel Australia Sydney, on 28 April 1906, George A. Taylor and Lawrence Hargrave conducted the inaugural meeting of the Aerial League of Australia. Hargrave had been persuaded to participate by Taylor and a fellow aviation buff Major Charles Rosenthal. At the time there were some forty people seriously experimenting with aviation in Australia.

Octave Chanute, the greatest authority on aviation of his day, proclaimed Hargrave in 1894 as the one scientist who really deserved to be the first to fly. One of the Wright Brothers is said to have told Hargrave's daughter "But for your father we would not be flying now. Except in the eyes of an enlightened few Hargrave was without honour in his own country.

George Augustine Taylor was a cartoonist for The Bulletin and Punch. With Edward Hallstrom he built a glider that on 5 December 1909 was the first manned aeroplane to fly in Australia. Hallstrom and Mrs Florence Taylor also flew the aeroplane that day. Florence participated in Taylor's experiments and is believed to be the first woman ever to fly in a heavier than air machine.

The occasion was noteworthy as perhaps the first instance of aviation safety regulation in Australia. To arouse enthusiasm an exhibition was staged in Sydney's Prince Alfred Park, a stone's throw from where the Aeronautical Engineering Department of The University of Sydney now stands. But there was an accident involving a balloon and tramway wires. The Sydney Town Clerk T.A. Nesbitt banned all air displays from the park forthwith. He sent police to break up an "unlawful assembly" when Taylor staged a model aeroplane contest there, and Hallstrom was arrested. The charges did not come to court.

The objects of the League as first adopted were thoroughly Chauvanistic but, as a result of Hargrave's efforts, were altered on 24 June to become "... giving a stronger impulse to the scientific study of aerial navigation, to

promote the intercourse of those interested in the subject at home as well as in different parts of the British Empire and abroad, and to aid with advice and instruction those studying the subject."

One of the earliest government functions of the League was to inspect aircraft submitted in response to the Defence Department's call in 1909 for military aeroplane designs. Taylor reported that during the first days of October 1909 "we inspected close to fifty to seventy models of kites, war balloons, aeroplanes and dirigibles."

The first powered aeroplane to be imported into Australia arrived in Sydney on 15 November 1909. It was a Wright owned by L.A. Adamson who also purchased a Bleriot. An import duty of 33% was imposed and this amounted to œ798 on the Wright and œ250 on the Bleriot. The duty was refundable if the aircraft were exported. Neither aircraft flew and Adamson is reported to have dumped them at sea after removing the engines. A similar tariff was applied to Houdini's Voison in 1910.

The Queensland Aero Club was formed in June 1910 with 40 members and a number of aeroplanes but in July the club changed to a Branch of the Aerial League of Australia.

J.R Duigan made the first flight of a totally Australian designed and built powered aeroplane in October 1910. The aircraft was the work of Duigan, his brother, and engineer E.J. Tilley, in the previous year.

Mr J.J. Hammond and L. MacDonald brought a Bristol aeroplane to Australia which as agents of the company they tried to sell to the Australian Government. Hammond, the first licensed New Zealand pilot, made the first flight over Sydney on 5 May 1911, but the Australian Government would have nothing of it and the aeroplane was bought for £1300 by William Ewart Hart, a dentist of Parramatta. The Bristol company refused to allow MacDonald to teach Hart to fly unless Hart agreed not to build aeroplanes in Australia. Hart would not comply and proceeded to teach himself. Hargrave's commentary on the affair was "Australia wants a cheap and handy machine that a jackeroo can pull out of its shed and go where the boss directs, returning before the old-time man has got his horse from the paddock. It won't be for want of trying if a suitable craft is not produced in Australia."

In November 1911, Hart rebuilt his storm damaged Bristol Biplane using Australian timbers and flew a series of test prescribed by the Royal Aero Club for the issue of an Aviator's Certificate. Under the supervision of the Aerial League he satisfied the requirements and thus became the first pilot to qualify in Australia.

On 9 May 1912 Hart was charged in the Sydney District Court with "propelling or causing to be propelled for a long time an aeroplane over, upon and against the plaintiff's land and making a great disturbance therewith and that he frightened, disturbed and stampeded a herd of dairy cows, whereby two of the cows were killed and others injured." The judge ordered that Hart pay the plaintiff's full claim of œ20 .

Taylor, Duigan and Hart were but three of a large band of aviation enthusiasts in Australia. Of those with real mechanical talent the three Harrys stand out. Harry Hawker, Harry Kauper and Harry Busteed left Australia in May 1911 to try to break into the aviation industry - to nurture the talents that had little hope of maturing in Australian soil. Hawker's achievements are now legendary. Busteed and Kauper are less well known to the Australian public. In the present context it is sufficient to observe that these men made outstanding contributions to the development of aircraft design and operation, taking the aeroplane from a fragile novelty to a militarily effective machine on the verge of commercial practicability.

On 3 August 1912 the first Australian to be killed in an aeroplane accident C.L. Campbell died shortly after crashing a Bristol Monoplane in England. (The earliest aviation fatality had been the death of a young bystander Tom Downs killed in a riot following a aborted balloon flight on 1 5 December 1856)

Modern Aeroplanes.

Some of the aeroplanes in Australia at that time were quite modern. In July 1914, for example, the first flight from Cairns was made by a Caudron G-11 of 1913 vintage. There were obviously well to do enthusiasts at large. The advantages to commerce were also clear. On 16 July 1914 the first Australian airmail was carried. A Frenchman, Maurice Guilleaux flew 1785 postcards weighing 40lb from Melbourne to Sydney at an average speed of 58mph.

The Australian Aero Club

The London Hotel in Melbourne was the venue for the meeting of military instructors and student pilots which, on 28 October 1914 decided to form an Australian Aero Club. Their objects were to advance the cause of aviation and to be a controlling body as well as a social club. The inaugural meeting of the Aero Club was held on 9 April 1915 with Lt Petrie as Chairman and Lt W.Sheldon as Secretary.

Air Navigation Regulations

On 10 March 1915 Royal assent was given to the Aerial Navigation Regulations promulgated under the War Precautions Act 1914. They were cancelled on 7 July 1915 and reissued on the same day under the Defence Act 1903-1915. Any one owning an aircraft was required to register it with the Commandant of the local Military District. Aerial navigation without registration was prohibited.

The first aircraft registered under the Regulations is thought to have been that built by H.C. Miller and R. Cousins. Almost certainly it was the first privately built aircraft to be registered in Australia.

Miller and Cousins typified the calibre of the men like Hinkler who left Australia to join the aviation industry overseas. They were followed of course by the stream of volunteers who went to fight in World War One 1914-1918. The Australian Flying Corp's No1 Squadron embarked for Suez on 16 March 1916. The commanding officer was Lieutenant Colonel E.H. Reynolds, Captains W. Sheldon and R. Williams and Lieutenant D.T.W Manwell were the flight commanders. They were joined in Egypt by Captain Oswald Watt an Australian who had been flying with the French airforce on the western front since 1914. These men were to be influential in the subsequent development of Australian civil aviation.

Foundations of Development

In November 1918 R. Lloyd sought registration of a company having the intention of operating between London and Sydney. His Aerial Services Ltd had an impressive board of directors but the Federal Government would not register the company because, according to the Post Master General, aerial services were only suited to densely populated countries and Australia would be the last country to require them.

By late 1919 "Australian aviation needed a focus for the considerable enthusiasm growing from the return of hundreds of Australian Flying Corps officers and men who, with the Australians also returning from the RFC RNAS RAF squadrons brought aviation in Australia to life. All over the Commonwealth they bought aircraft from disposals and tried to make a living barnstorming, or by aerial photography, or any other use of aviation. The public regarded them very much as intrepid aviators, a freak race, and to be a passenger in an aeroplane

was to achieve considerable local fame - a fact which made barnstorming flights possible at five pounds a head."

Never the less, the public and especially prominent business men "were conscious that in the aeroplane the Australian enemy - space, mileage, distance - could be defeated." General Legge Chief of the General Staff of the Australian army had for example, already advocated the further formation of aero clubs as an aid to the developmemt of aviation. G.F. Holden, chairman of the Melbourne Harbour Trust, had spoken of the practicability of aerial mail and fast freight between the capital cities. Reginald Lloyd had finally managed to get Aerial Services Ltd, registered upon the recommendation of British authorities and had surveyed the Australian end of the route by 16 January 1919.. This is said to have been the first company of its kind registered in Australia.

C.A. Jeffries wanted to begin passenger services throughout Australia using the 21 seat Handley Page. He asked for a Department of Aviation to be formed to make safety rules.

Of the dozen or more aviation companies founded in 1919 only one of the airlines survived -The Larkin-Sopwith Aviation Company of Australasia Ltd. However, a number of what we would now call charter operators remained in business, as did several aircraft manufacturers and repairers. For example, H.T. Shaw and R. Ross Engineering and Aviation Company at Fisherman's Bend, C. Pratt's Aircraft Manufacturing and Supply Company of Australia, and Pratt Aviation Company at Geelong, and Nigel Love and Harry Broadsmith's Australian Aircraft and Engineering Company Ltd, at Mascot, together with Aeroflights Company of E.J. Jones, Mackenzie and S.G. Brearley at Hamilton, as well as the enterprises of Butler, Kauper, and Norman Brearley.

Several companies in other industries had also begun to use aircraft in the course of their business. But, "by the end of 1919 companies with an aggregate capital of two and one half million pounds had gone into liquidation after making a hash of their aviation ventures." "Fifteen different aviation organisations appeared in 1920 to enjoy the final fling" "before efforts by legal authority to demand certain standards of aircraft and crews". Only one survived - Queensland and Northern Territory Aerial Services. "It is incredible to read the accounts of what was done with primitive aircraft by completely unqualified pilots and operators. Aircraft were bought and sold throughout 1919-20 without thought for life and limb. You simply bought an aeroplane and took your own sweet will with it."

There were at the time some air-minded people with considerable influence. They included Prime Minister William Hughes, Defence Minister Sir George Pearce, and Chief of the General Staff Major General Legge. On 19 Mar 1919 the Commonwealth Government announced that in order to stimulate aerial activity it would award ten thousand pounds to the first Australian to fly a British built aeroplane from England to Australia. Some competitors attempted to make almost immediate starts without adequate preparation and in consequence on, 12 June, Hughes announced additional mandatory safety requirements, including an earliest start date of September 1919.

On 23 May 1919 the inaugural meeting of the NSW Branch of the Australian Aero Club had been held. H.C. Macfie was elected President. E.J. Hart the editor of "Aircraft" as Secretary was authorised by the meeting to approach General Legge to discuss development and control of civil aviation.

Macfie who was also Chairman of The Aerial Co Ltd went to London to discuss civil flying regulation with the Air Board in August 1919. At the same time he gained the Australasian agency for Short Bros.

Queensland and South Australian Branches of the Australian Aero Club were reformed during September 1919. In the same month, the Aero Club called on the Government to exercise some control over the proposed England to Australia air race. General Legge agreed, and the Government responded.

Next the Aero Club, with Oswald Watt as Chairman, wrote to the Prime Minister expressing its disapproval of the lack of control over flying and pointing to the British Air Navigation Act which had received assent in May 1919. Some irony was seen in the absence from the Constitution of any mention of control over aviation. The Australian Parliament simply did not have power to make laws about air navigation, and there had grown a traditional reluctance for the State Governments to concede any more powers to the Commonwealth than already expressed in the Constitution. There was a general realisation that the cost of providing the infrastructure and the regulatory machinery would be substantial.

The Aero Club began a major campaign to persuade the States and the Commonwealth to agree on a control system. They attracted considerable support. " The earliest initiative toward tackling the legislative issues came from the Air Traffic Committee of the Council of Defence which had been set up by General Legge. The Air Traffic Committee asked the Prime Minister to request the Attorney General to advise `on the Constitutional position of the Commonwealth in regard to legislation on the subject of aerial navigation and a possible reference of the subject to the Federal Parliament under Section 51 of the Constitution' which provides for reference of power by the States." General Legge believed that there should be only one regulatory air authority for Australia and only one set of laws. He was also conscious of the need to comply with international law and agreements. Despite initial reluctance, by the end of 1919 most of the States had agreed in principle to refer their powers in the matter to the Federal Government. NSW however was holding out.

The Air Navigation Act

Paris Convention

1919 was the year of the Peace Conference following World War One. The Supreme Council of the Peace Conference on 10 September 1919 approved the International Convention for the Regulation of Aerial Navigation which had been developed during the year by the Allied and Associated Powers serving on the Conference's sub-committee the International Commission. This is now known as the "Paris Convention".

Article 35 of the Convention created the International Commission for Aerial Navigation (ICAN) which was to develop the provision of the Convention by a series of Annexes that would deal with:

registration and marking of aircraft (It was the ICAN that assigned the letter G to aircraft of the British Empire and G-AU to Australia.)

certificates of airworthiness

log books

competence and licensing of personnel

meteorological services

mapping and ground marking

Australia signed the Convention on 13 October 1919 along with thirty seven other States and with the notable exception of the USA. In so doing the Australian Government created an obligation to put the Convention into effect through Australian law.

The USA and some South American states developed a regional agreement in 1928 somewhat similar to the Paris Convention. This was the Havana (Pan American) Convention. Spain and twenty Latin American states signed the Madrid (Ibero American) Convention in 1928.

It has been alleged that the most important reason for the USA not ratifying the 1919 Convention was that they could not or would not meet the airworthiness standards of the Convention. The American Patent Office also questioned the signing of the Convention because of the implications for the power of US courts in patent actions. An effect of the Convention was to prohibit the operation of aircraft of American and German operation throughout the British Empire unless their airworthiness was certified by Britain or a Dominion. Thus the commercial advantage of the control of airworthiness standards, and the design standard in particular, was an issue from the very beginning.

By this time the Federal Government believed that there were powers in the Constitution which could be used as a firm base for federal legislation on civil aviation matters. There were powers to make laws about trade with other countries and among the States, about postal and other like services, as well as defence and external affairs powers.

In January 1920, the Premier of NSW, Mr Holman, agreed with the proposals made by the Aero Club and reached substantial agreement with General Legge representing the Commonwealth.

The Australian Aero Club next formed its own technical committee to oversee airworthiness and instituted its own Certificate of Airworthiness.

During this period there were some regulatory oddities. A local Roads Board in the Kimberley district of WA attempted to collect a Wheel Tax on aeroplanes that had been levied by the State Government. The impost was challenged by owners of cattle stations in the district.

A Bill for an Act

On 2 March 1920 the Prime Minister Mr Hughes announced that there would be a Bill in the current session to control civil aviation.

Lieutenant Colonel H.C. Brinsmead MC returned from overseas in 1920, as a civilian, to take over the army's post of Staff Officer Aviation from Colonel Reynolds. Brinsmead was met on arrival in Sydney by Watt who, it seems, decided in his own mind at least that Brinsmead should become the controller Watt sought for civil aviation. Brinsmead was neither pilot nor mechanic. He had been so badly wounded on the Western Front as an infantry officer that he was unfit for further service and transferred to the staff of the Australian Flying Corps, becoming Staff Officer Aviation in London.

A conference was held in May 1920 between the Federal Government and the Premiers to examine the matter of air legislation. On the motion of the Prime Minister they resolved to refer the control of civil aviation to the Commonwealth Parliament, but reserved the right for States to have state-aircraft, and agreed for the time being to each enact legislation for uniform regulation of aviation similar to the British legislation. There were further delays, and in response to public pressure, including that of the Aero Club and the Society of Australian

Aircraft Owners, the Federal Government prepared its own legislation. The State Premiers were advised in advance and were told that separate State legislation would not now be needed.

On 17 September 1920, during the Budget Debate, the Defence Minister Senator Pearce made the following statement. "We have endeavoured to devise an effective means of ensuring the full consideration of matters of aviation policy as a whole in its naval, military, and civil aspects. The Minister will be assisted by representatives of the Navy and Army, by the Air Board and an independent Controller of Civil Aviation. The Controller will take a seat on the Air Council.

The Commonwealth is a party to the International Convention for the Regulation of Air Navigation, and the Premiers of the States have agreed that the subject matter be referred to the Federal Parliament. A Federal Bill is being drafted in anticipation of the necessary State legislation being passed ..."

The formation of of an Air Board to control the planned Australian Air Force had been agreed on in April 1919 and a provisional Board had existed since November 1919, reporting to the Air Council.

The Civil Aviation Branch

The Controller of Civil Aviation was to be the head of the Civil Aviation Branch of the Department of Defence and responsible for the administration of traffic regulations, and the inspection, registration and certification of airmen, aircraft and aerodromes. He was to advise on the organisation of airlines and schemes for the encouragement of the growth of civil aviation.

In the event, although Victoria, South Australia, Queensland and Tasmania passed their legislation referring powers, only the Tasmanian Act was proclaimed. The Commonwealth proceeded without the formal concurrence of the States by using its external affairs powers.

On 11 November 1920 the Air Navigation Bill was passed - becoming law on 2 December 1920 and to have effect from 28 March 1921. It purported to control all air navigation throughout Australia and its territories, its main purpose being, said the Minister, to specify conditions for the licencing of pilots and aircraft and not to wipe out private enterprise.

Note the necessity for consistency with the Air Navigation Regulations 1915 which began by prohibiting navigation by unregistered aircraft. Note also the necessary connection "Air Navigation" in the title of the Act with the international convention which under the external powers arrangements so as to give the Commonwealth the right to legislate on the matter.

The Act was not wordy. It only had four paragraphs. It gave the Governor General power to make regulations giving effect to the Paris Convention on minimum standards for air navigation. In anticipation of the States' referring power it also gave the Governor General authority to make other regulations for the control of civil aviation throughout Australia. The job of Controller was advertised shortly and Colonel Brinsmead was appointed on 16 December 1920. His salary was to be £750, rising by £50 annual increments to £1000. In contrast, the salary simultaneously offered for the similar job by the Indian Government was £2000.

Air Navigation Regulations 1920

The Air Navigation Regulations drafted by Brinsmead and issued under the Act by the Federal Executive Council on 11 February 1921 were based on those adopted by the 1919 International Convention (the Paris Convention) They took effect from June 1921. It is interesting to note that there was no provision in the Regulations for a third level of rules such as Orders.

The Regulations were "bitterly attacked by a great many individualists. Licences were required, aircraft had to be registered ... and it is a matter of record that medical examination of pilots and airworthiness examinations of aircraft eliminated many men and machines." "Few officials could have combined the coolness, tact and energy of Brinsmead at such a time in the face of considerable abuse from people who had been his friends, but he had the backing of a solid section of the aviation industry."

"It is difficult to name any other industry in which the Commonwealth Parliament and Government have been so comprehensively and directly involved. No State Government wanted to assume the responsibility - especially the heavy technical and financial burdens involved. The objective of ensuring safety of flight could not be left to enterprising but unregulated operators or to a doctrine of survival of the fittest."

Trends In Regulation

"The immediate task of the Civil Aviation Branch was to introduce and apply safety measures in the checking and licensing of pilots and the airworthiness of aircraft and the qualification of engineers and mechanics who were made responsible under the Regulations for the day to day condition of the aircraft." Brinsmead divided his Branch into three groups each with a Superintendent: Personnel and Flying Operations under Captain E.J. Jones, Aerodromes and Aerial Routes under Captain E.C. Johnston, and Aircraft under Captain F.W. Follet. The Chief Clerk was Captain S.H. Crawford. They licensed their first aerodrome, at Fisherman's Bend, on 1 June 1921 and investigated their first fatal accident ten days later.

The first civilian licences were issued on 28 June 1921, the date on which the ANRs became effective. There were forty five pilots and 142 aircraft maintenance engineers. H.C. Miller featured in both categories. Brinsmead's original surveyors were: H.T. Shaw, Matthews, Moody, Sansom, Fysh, Miller, Kingsford Smith, Brearly, Mustard , Charles Pratt, Parer, and Treacy. The only inspector of aircraft was R.H. Buchanan. There were thirty eight aircraft of thirteen types on the Register.

In July Brinsmead reported that "...the financial position of practically every firm now operating aircraft is extremely precarious. ...The reason for this depression is not hard to find, as undercapitalisation, inefficient machines and lack of adequate organisation is common to most of the concerns. ... The position is deplorable but in no way disastrous as it should be realised that civil aviation has not yet really commenced in Australia and will not do so until such time as well organised and adequately financed companies are flying up to date machines over approved routes.."

On 18 July 1921 Brinsmead released the text of a letter to F.S Briggs a well known experienced commercial pilot, pleading with him not to attempt a Melbourne-Hobart-New Zealand solo flight in a DH4 because of the risks involved and the implications of failure for civil aviation. Briggs was an airman of some repute who made many outstanding flights in Australia particularly in the company of De Garis and Birtles. The flight was stopped by refusing a Certificate of Airworthiness for operation at 250lb overweight.

At the Premier's Conference in November 1921 it was resolved that the uniform legislation for the control of air navigation agreed upon at the previous Conference be pressed forward. As it stood, Victoria and South Australia were still controlling all aviation within their own borders.

In December 1921 the first licenced aircraft maintenance engineer examinations were conducted.

During that year, Nigel Love's company, which was assembling Avro 504Ks in NSW, lobbied successfully for a tariff on imported aircraft. The Tariff Board proposed to Parliament that there be a 25% import duty on British manufactured aircraft and 35% on those from other countries. `Aircraft' magazine strongly opposed the idea and the duty was not applied for six years. The Civil Aviation Branch purchased its first aircraft in September 1921 - an imported Bristol Tourer.

Brinsmead had been told on taking office that he should make arrangements for interstate airmail services. His efforts were abortive. The Department of Home and Territories purchased suitable sites for the necessary aerodromes in capital cities and rural centres but only the Geraldton to Derby route was of interest to any operator. The contract for that service was granted by the Defence Department to surveyor Major Norman Brearly who sub-contracted West Australian Airways Pty Ltd for the job - the company having been formed in Perth specifically for the purpose. Brearly personally tested the pilots for the service. It seems that the contract required the service to commence within ten days of aircraft becoming available. We can only speculate about why such a restrictive provision was placed on tenderers and whether it reduced competition or not.

The first day of operations was 2 December 1921 and on that day there were three accidents and two fatalities. The aeroplanes used were converted Bristol F2b Fighters known as Bristol Tourers. Daily newspapers and the Bulletin attacked the Government for allowing airline services to begin so early in the development of the aeroplane.

Within a year WA Airways was carrying 10,000 letters a month.

On 2 November 1922 Queensland and Northern Territory Aerial Services began operating under the licence granted to them for the Charleville to Cloncurry route. Their aircraft were two Armstrong Whitworth FK8 and a DH4. This service linked the ends of the three Queensland railways.

Thus by the end of 1922 regular aircraft services in the bush were a fact, but the intercapital services had not really got off the ground. The bush services were heavily subsidised by Government. A good deal of the trouble with the intercapital services seems to have centered on personalities.

H.J.Larkin was perhaps the stormy petrel of early Australian aviation. He served at Gallipoli as a sapper and after transfer to the RFC shot down eleven enemy aircraft. The first service between capital cities, Adelaide-Sydney, was contracted to Larkin on 21 December 1921 then proprietor of Larkin Aircraft Supply Co (LASCo) The second, Sydney-Brisbane, was contracted to F.L. Roberts. Larkin amalgamated with Roberts to form Australian Aerial Mail Services Ltd and take over both contracts. Annual costs were expected to be œ33000 and there was a total subsidy of œ29000 . The service did not begin until June 1924 and the Sydney Brisbane leg was never flown. The existence of Larkin's contract prevented another company, such as Nigel Love's, taking over the route.

The Sydney to Adelaide service commenced on 2 June 1924 using an assortment of Sopwith aircraft, Wallaby, Antelope and Gnu, plus the pioneering DH4 of F. Briggs. The weather was a constant enemy and the pilots had

to have a good eye for a forced landing field. The routes were recast in 1925 to help overcome operational difficulties.

Under all these early contracts the Government through the CAB accepted responsibility for providing emergency landing grounds enroute. The policy was that an aircraft flying the contract route should be able to glide to a landing following engine failure without undue risk of major injury to passengers. The ELG were set out at 15 mile intervals corresponding to a cruise altitude of 8,000ft.

In April 1923 Larkin suggested that control of civil aviation should be vested in a board rather than be the responsibility of one man. He claimed that several matters vitally affecting civil aviation required urgent attention. He sought:

> the establishment of an accidents investigation committee that would investigate and make public the reasons for every incident
>
> provision of wireless on organised routes
>
> encouragement of aircraft manufacture in Australia by private enterprise
>
> increased aerial services, and
>
> the formation of an insurance pool.

By 1924 there were only thirty seven licensed pilots in Australia and only thirty six aircraft with Certificates of Airworthiness. There were ninety four licensed aircraft maintenance engineers and the Civil Aviation Branch had a staff of eleven men.

Larkin's subsidies were gradually withdrawn. In 1934 his company went into liquidation. Its assets were bought by New England Airways which was in the Airlines of Australia Ltd organisation which itself became ANA.

Amateur Built Light Aeroplanes

Aircraft surveyor T.E. Johnson reported to the Controller of Civil Aviation in August 1926 and January 1927 that the light monoplane which Mr E. Prosser was building for the "purpose of flying all over Queensland" ... "and selling thousands of them" was: "weird looking and brings one back to the 1903 designs. ... I would suggest that, in view of the departure from the use of specified aircraft materials and the inferior workmanship and unorthodox methods of construction throughout, he be advised that any flight carried out will be at his own risk"

In May 1927 the Civil Aviation Branch advised Mr Prosser that under no circumstances would they grant permission to fly the machine.

Commercial Pilot Licences

H. Larkin proposed, in December 1926 following a fatal accident involving a Curtiss Jenny flown by a newly licensed pilot, that pilot tests should be more stringent, that the 1919 Convention had only specified minimum and not desirable standards, and that ten to fifteen flying hours is not sufficient to demonstrate competence. Colonel Brinsmead argued that an isolated incident was insufficient demonstration of deficiencies in the system and opposed extremes of regulation. In January 1927 it was announced that pilots licences would be endorsed

to the effect that pilots with fewer than forty hours should not fly passenger carrying aircraft in any circumstances. The Regulations were not amended.

Airline Productivity

The commercial achievements of the contract airlines especially in remote Western Australia and Queensland, were substantial. During any one month in 1927 they could be expected to carry 22,000 letters, 5500lbs of freight, and 350 passengers over 40,000 miles. As at 30 June 1927 there were 99 licenced pilots, 46 of whom were in Category A Private and the remainder in Category B Commercial. There were 136 licensed Ground Engineers. The list of names is an Australian aviation Who's Who ,

Accident Investigation

In the first few months of 1927 there were a further four fatal accidents. In May the Minister for Defence announced a Departmental inquiry into accidents over the past year, and the Prime Minister announced the formation of a permanent Air Accidents Investigating Committee which was also to study accident causes and preventative measures. The reporting of accidents was to be mandatory. The Air Navigation (Investigation of Accidents) Regulations were promulgated on 13 October 1927. The Australian Aero Club did not agree with the procedures proposed, the selection of people for the Committee, and the terms of reference for the immediate inquiry. They offered expert assistance but the Minister did not consider that it was necessary.

Over water Flights

In September 1927 the Prime Minister made a statement to the effect that action would be taken to prevent long over-water flights by aircraft not suited for the purpose. The Commonwealth, he said had the power to prevent the carriage of passengers for more than 50 miles over the sea in any thing other than a seaplane. A proposed flight to New Zealand in a Bristol Fighter was abandoned. The NSW Government refused further aid to Kingsford Smith's proposed trans Pacific flight.

Selective Import Prohibitions, Export CofA

Three officers of the New Zealand Territorial Air Force shipped a Ryan B1 to Australia to attempt a flight from Australia to New Zealand. The Federal Government objected to the flight because it was believed that the aircraft was not suitable. It was not certified as airworthy in Australia because America, the country of manufacture, was not a signatory to the 1919 Paris Convention. American aircraft were not as a rule built to specifications acceptable to the UK Air Ministry. Some types were acceptable to Canada and ipso facto to all other parts of the Empire. It was not known whether the Ryan had been certificated by Canada. By January 1928 the dificulties were resolved and the aircraft was registered in Australia. During the flight to New Zealand the Ryan disappeared without trace.

In June 1928,the month following Kingsford Smith's first trans Pacific flight in the Southern Cross, doubt was raised about the eligibility of the aeroplane for registration in Australia. Under the terms of the Paris Convention it could not be registered because it was manufactured in the USA which was not a signatory to the Convention and which prima facie did not subscribe to the airworthiness requirements of the Convention. The same reservation applied to a number of other types from the USA and from Germany then operating in Australia. In September 1928 the Federal Government amended the Customs Act to prohibit the importation of aircraft which did not have a Certificate of Airworthiness issued or endorsed by a country which was a signatory to the Convention.

This episode revived allegations that the Air Navigation Act 1920 was invalid because only two States had passed legislation giving appropriate authority to the Commonwealth.

CAB Manpower and Regulatory Difficulty

Lt Col Brinsmead told the 1927 Royal Commission on the Australian Constitution that the growth of the work of the Civil Aviation Branch, which only had fifteen oficers, was so great that it would soon be necessary to have a permanent officer in each State capital. Unless the Commonwealth were given power over aviation, the chief problem would be the increasing number of itinerant fliers. It was unsound he said to administer aviation by regulations.

Validity of Air Navigation Act

On 15 November 1927 Edgar Percival appeared in court charged by Federal officers with flying an aircraft that was not airworthy. Percival's defence was that, since the aircraft had never flown outside the State, the Commonwealth Act was not applicable. His counsel made further submissions that the Air Navigation Act 1920 was ultra vires and that the court was not competent to deal with the matter. Percival was fined ten shillings.

During September 1928 increased civilian aviation activity prompted the Commonwealth to examine its power to control the detail of private flights and of long flights over water. A search of the existing legislation revealed that the Commonwealth had no power over flights unless they became interstate flights. The power over flights leaving Australia was in doubt because Commonwealth jurisdiction extended only to the three mile limit. So far as could be determined the power to control the movement and the design and airworthiness of aircraft in single States rested with the State authorities. The Royal Commission on the Constitution, then sitting, recommended that the Commonwealth seek full powers from the States.

Remote areas

The recommendations of the Committee of Inquiry into the Coffee Royal affair of June 1929, in which lives were lost searching for Kingsford Smith and his crew, included:

preparation of more accurate maps of unsettled areas of Australia

construction of compass swing bases at each capital city

regulation to specify equipment instruments maps etc to be carried on flights outside settled areas

fitment of radio to aircraft flying beyond settled areas (the radio to be capable of transmitting from the ground)

certified inspection of aircraft setting out on flights to unsettled areas.

Australia to England and the DH86 Affair

Against a background of numerous private flights and commercial proposals the Commonwealth Government set up a committee to investigate the development of air communications between Australia and the United Kingdom and within Australia. The Committee submitted its report in 1932 and tenders were shortly called for the services it had recommended. The successful tenderers were:

Qantas Empire Airways operating de Havilland DH86s on the Singapore- Darwin- Charleville- Brisbane leg,

C.A. Butler with DH84s Charleville to Cootamundra,

McRobertson Miller with DH84s Katherine to Perth,

Tasmanian Aerial Services with DH86s Melbourne Launceston Hobart.

The first service began on 1 October 1934 and on 19 October a DH86 crashed into the sea enroute from Launceston to Melbourne in clear weather. Thirteen occupants were killed including Captain Victor Holyman. The investigating committee recommended a number of changes to operational procedures including the carriage of reserve fuel. Three weeks later another DH86 crashed, spinning into the ground just after take-off from Longreach killing all four onboard.

Following investigations in England and Australia, the aircraft type was modified by removing the rudder servo control and strengthening the fin forward attachment early in 1935. The overseas service became a popular financial success. On 2 October 1935 Holymans lost another DH86 into the sea with five fatalities. This caused a major enquiry. The most senior aeronautical experts in Australia tested and otherwise examined the aircraft exhaustively. No cause could be attributed. During the course of the investigation another Holyman DH86 force landed when the pilot suspected structural failure. As a result the Cs ofA of all DH86 in Australia were suspended. When the cause was found to be a loose fairing caused by poor design and bad maintenance the suspension was lifted. The Controller of Civil Aviation was ordered to devise means of ensuring that all commercial aircraft were regularly inspected before flight.

A Watershed The Goya Henry Affair

In 1934 Mr Henry Goya Henry was prosecuted and convicted of flying an aeroplane without a licence. The flight was within State boundaries and Henry challenged the conviction. The High Court, in 1936, held that the Regulations could not deal with intra State aviation even to the limited extent necessary in implementing the Paris Convention, because the Convention did not require the Commonwealth to implement a system of pilot licencing for intra State aviation. The Court also ruled that the Commonwealth could not, through its trade and commerce power, exercise general control over civil aviation including intra State aviation. Because the invalid sentence in the Act was not separable from the section of which it was a part, the whole section was regarded as invalid. So too were the Air Navigation Regulations that had been raised under the Act.

The Civil Aviation Board

The Commonwealth Government immediately amended the Air Navigation Act in such a way that the Governor General's Air Navigation Regulations would not apply to intraState aviation except as they implemented the Paris Convention. A new set of Air Navigation Regulations was raised. An important difference in the new ANRs was that whereas the Minister for Defence had previously been empowered in several Regulations to approve or make directions, that power was transferred to a new body known as the Civil Aviation Board.

The limited extent of the Annexes to the Paris Convention meant that, for intra State aviation, the requirements for licencing and airworthiness became rather liberal. Accordingly the Commonwealth Government conducted a referendum for a Constitutional amendment that would give the Commonwealth Parliament the necessary power. The proposal was defeated at the referendum.

A Commonwealth Department of Civil Aviation

In April 1937, at a meeting of Commonwealth and State Ministers it was agreed that the States would each pass a uniform Air Navigation Act which said that the Air Navigation Regulations of the Commonwealth were also Regulations under the State Air Navigation Act. The State Acts were in place by 1938. The practical result was that Commonwealth control of air navigation, as distinct from the economics of air transport, was now accepted. In November 1938 a new Commonwealth Department of Civil Aviation was created to administer the Air Navigation Act, supplanting the existing arrangements.

Mr Henry was not yet done. After having been convicted of a low-flying offence, before the State Acts were in place, he pushed an appeal as far as the High Court claiming that the wording of the ANR on the subject was substantially different from that of the Convention and was therefore outside the Commonwealth power. The Court held, in 1939, that a meticulous adherence to each provision in the Convention was not necessary, but, that ANRs could not deviate in substance from the terms of the Convention.

Enter ICAO

As World War II 1939-45 drew to a close, it became clear that new arrangements would be necessary for the control of civil aviation. A conference was held in Chicago in 1944 which resulted in an Interim Agreement establishing a Provisional International Civil Aviation Organisation. The Chicago Convention proper came into effect on 4 April 1947 and with it ICAO. The principle of the Convention was to establish preconditions by which any signatory country would permit the commercial aircraft of other countries to fly into and over its territory.

The new Convention recognised the developments in aviation by specifying minimum standards in fifteen Annexes. Annexe 8 for example dealt with airworthiness. It required participating States to promulgate their own national design standards conforming with the Annexes, and it spawned several technical airworthiness manuals. The Annexes and manuals continue to be revised and expanded.

Note that the Convention deals only with international flights.

To give effect to the Chicago Convention the Air Navigation Act 1920 was amended in 1947 and a new and far more comprehensive set of ANRs was issued. Power to administer civil aviation was vested by the Regulations in a Director General of Civil Aviation. ANR 8 empowered the Director General to issue Air Navigation Orders. In fact, ANOs were the only medium available to him until the ANR was amended to permit other instruments in writing.

A second amendment to the Act in 1947 stated that the Commonwealth had power to make regulations on matters in addition to those dealt with by the Chicago Convention. The Commonwealth clearly had this power over international air navigation as a result of the Constitution, and the Constitution was not regarded as limiting the power to regulate standards procedures and organisation in all matters in which uniformity would improve air navigation. But, there was still an area of uncertainty with respect to intra State air navigation. The seeds for a future test case were sown in 1956 when the amended Act was used to make the Regulations applicable to air navigation in controlled airspace that directly affected the safety of international and inter State air navigation.

The 1960 Expanded Act

In 1960 the Parliamentary Joint Committee on Public Accounts criticised the extent to which aviation regulation relied on subordinate legislation such as ANRs. In response the Commonwealth Government expanded the Act by transferring into it much of the material that did not need to be in ANRs for the control of intraState aviation or to satisfy the Chicago Convention.

In addition, the power of the Governor General to make regulations was extended to matters such as registration marking, airworthiness, licensing of air transport operations, safe operations, and maintenance.

Federal Control

In 1963, during a High Court case involving Airlines of NSW and the NSW Government, it became clear that the Court considered the Commonwealth could make the Air Navigation Act and Regulations applicable to all flying operations in Australia. In 1964 the Prime Minister advised the State Premiers of his Government's intention to assume comprehensive control over civil aviation and the Regulations were further amended to apply to all air navigation in Australia.

In 1965, in a second case involving Airlines of NSW, the High Court upheld that amendment on the ground that Commonwealth control of intra State air navigation was, under the conditions now prevailing, a necessary means of ensuring the safety of international and inter State air navigation. The State Parliaments had a valid concurrent power to regulate intra State air transport for reasons other than navigation. For all practical purposes, the uniform State Air Navigation Acts were no longer required.

Summary Observations

Australians have been active and successful aircraft designers since the beginning of manned flight. During the development of Australia's aviation regulatory environment the principals of Australian aviation knew from personal observation what was required to make an aeroplane effective and safe and how to go about achieving that.

In the history of Australian aviation it is clear first of all that regulation has been prompted by concern for public safety and reliable commerce.

Development of commerce over the inhospitable distances in Australia, and between Australia and Europe, made it important that practical aeroplanes be available in Australia for quite ordinary purposes. Such aeroplanes were not really available until the importation from 1927-28 of the Fokker VII, the Junkers G31 and W34, the deHavilland DH 60 Moth and Avro Avian, and the DH84 Dragon, although the basic Junkers F13 had been available rather earlier. In the preceding ten years a great deal of personal talent and energy was disipated trying to make a commercial success of unsuitable aeroplanes.

The disastrous commercial consequences of aircraft accidents remains a valid lesson of the first fifty years as does the dependence of new air transport developments upon financial guarantees from outside the aviation industry.

Much of Australia could be formally classified as "remote area". That has important implication for the reliability demanded of aircraft - and of airliners in particular. Australia has grown up with that remoteness and behaves as though unaware of the signifigance, even though successive courts of inquiry have emphasised the

fact. Twin engined Transport Category aeroplanes are permitted to operate considerably further from safe landing grounds in Australia than they are in Europe or North America.

The continuing efforts of vested interests to manipulate regulations for commercial gain are as visible in retrospect as they must have been at the time. Governments, companies, and individuals were all involved. Though the protests of adventurers with more or less influence have punctuated the proceedings from time to time, those in authority were not prepared to allow the attitudes of adventurers to prejudice public safety or to jeopardise the reputation of an emerging air transport industry.

"The objective of ensuring safety of flight could not be left to enterprising but unregulated operators or to a doctrine of survival of the fittest."

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