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A SYSTEMIC INVESTIGATION INTO AUSTRALIAN AVIATION SAFETY

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Abstract

Aviation represents a complex socio-technical system in which a strong emphasis is placed upon safe operation. Advances in this area have traditionally been reactive following particular incidents or accidents. As the traditional accident causes (predominantly technical engineering factors) have become better understood, the need for proactive solutions to counteract the increasing contribution of human performance to accidents has grown.

This paper presents the results of a systemic case-study investigation of the reasons behind Australia's good record for airline safety. Initial conclusions pointed to the existence of a number of natural environment factors which are perceived to have a beneficial effect on flight safety. However, deeper examination has suggested that there are a number of cultural factors within the human and operational environments which exist at professional, corporate, industry and national levels. These have contributed to the quality and quantity of risk countermeasures which have been instrumental in creating the good safety record. This paper explores the importance of these influences and how they may be changing in the current and future aviation environment.

Methods of Investigation

Accident investigation is, by its nature, reactive. In aviation terms, the definition of an accident means either a serious injury or fatality has taken place involving passengers or crew, or the aircraft has received substantial damage.[1] Accidents have provided a wealth of information and experience from which the industry has developed, but at considerable cost.

Fortunately, accident investigation has moved on. A 'single cause accident' now represents a failure of the accident investigation process rather than in supporting the long-standing view that accidents can happen as a result of a single failure such as 'pilot error'. Aviation is supported by a myriad of safety defences which range from hard engineering solutions such as duplication or automatic safety devices to the softer, human interventions of experience and airmanship. As such, it is inconceivable that the system could fail to the point of an accident without multiple failures.

Whilst accident investigation can claim responsibility for significant advances in understanding and future accident prevention, the industry has matured to a point where there are no new accidents, only variations on a recurrent theme. By definition, accident investigation comes too late for at least one crew and such a cost is unacceptable.

A more recent shift towards incident investigation and the collection of incident reports represents an attempt to maximise use of available data. If an incident may be assumed to be an accident which didn't happen, perhaps because of last line defences or circumstances on the day, then analysis of incidents may provide additional data at minimal cost.

Incident reporting and the quality of data it produces are highly dependent upon what information is collected. Whilst aircraft accidents are difficult to hide, incidents are rather easier. In environments where blame and punishment are still existent, the opportunity to 'get away with it' may overcome an desire to report an incident for accident prevention purposes. It is bearing this in mind that confidential reporting systems have developed and as experience shows, the effect has been an apparent increase in incidents. Of course, the truth is that it is not incidents which have increased in number, but rather the proportion which are reported.

However, even incident investigation does not fully meet the criteria of proactivity. Each incident represents a failure of a safety system and the difference between an incident and accidents may have been quite marginal. A truly proactive system would look at system safety health well before incidents or accidents occurred.

In 1993, Reason[2] challenged an IATA conference by asking "Should we not be studying what makes organisations relatively safe rather than focusing upon their moments of unsafety? Would it not be a good idea to identify the safest carrier, the most reliable maintainer and the best ATC system and then try to find out what makes them good and whether or not these ingredients could be bottled and handed on?"

Loughborough University Air Transport group rose to the challenge by using Australia as a case study to examine the components of a safe system. This choice recognised the apparently excellent record for Australian airline safety: No lives have been lost in a commercial jet airline accident in Australia or on Australian carriers overseas. Whether this makes Australia, or Qantas, the safest in the world is not an issue. Each airline has a unique set of challenges and operations and past record is no guarantee of future success. What is significant is that the Australian system is repeatedly rated as excellent. [3,4,5,6,7]

Positive case studies, i.e. those which examine what was done right, have certain natural advantages over incident or accident investigations. For example, expert witnesses are often more than happy to talk about what they do well.

A Systemic Approach

In considering the safety of Australian commercial aviation, it has been necessary to try and understand how a multiplicity of factors have interacted in a system of considerable complexity. This systemic approach has required examining time-series data collected through a series of primary and secondary techniques, and covering a period where technological and human system changes have been, at times, dramatic. Aviation is still an industry in its infancy. This is illustrated by the fact that Qantas co-founder and eventual Chairman, Hudson Fysh, saw the airline's equipment go from the first 'rag, stick and wire' Avro 504K to the introduction of the turbojet Boeing 707 all whilst he was still an employee.

Attempting to learn from the successful aspects of the Australia aviation system requires focus at both the micro and macro levels. Different safety issues often achieve disproportionate levels of attention; either in response to recent accidents or indeed because of an apparent lack of accidents. It is easy to be misled as to the individual influence of different factors, and case studies have to be wary of uneven coverage. Notwithstanding this, the relative importance of different elements of a safety system can change over time to reflect advances in technology or training. For example, whilst weather remains an important influence on aviation, technological advances such as instrument landing systems (ILS), jet engines and weather radar have altered the significance of the threat.

As such, it is all but impossible to develop a calibrated universal model to describe a safe aviation system based solely upon this case study of Australia. It is nevertheless possible to highlight the relative merit of each of the areas examined within this case study based upon their effect on the accident record, perception and future potential. The results of this systemic investigation are presented here, divided into risks and their countermeasures and separated into three environments of analysis.

The risk exposure of the system

Hazards to the safety of the Australian commercial aviation are summarised as follows;

Natural Environment

In the natural environment, anecdotal focus tended to be predominantly aimed at the positive aspects of the 'relatively benign climate' and 'good aviation weather'. However, there are a number of significant threats which deserve highlighting. Australian aircraft are likely to encounter strong microburst and windshear conditions, especially in the tropical and subtropical regions of the country including large ports such as Perth and, in particular, Sydney. Fear of microburst / windshear encounters was significant amongst Australian crews, largely because when it is encountered at low level, it is very difficult to recover. It is also a phenomenon which is

poorly predicted and lasts for only a short time. An approach or take-off in such conditions is also prone to additional risk due to aircraft operating at maximum take-off weights or at the end of long sectors, or lack of familiarity from overseas carriers. This can be further exacerbated by commercial pressure to 'get-in' to this busy airport, approach and departure procedures which are confusing and frequently changed, and the expectation that '...it doesn't happen here'. While the number of windshear / microburst related accidents recorded in Australia is low, this does not mean that the incidence of the phenomena is insignificant. This is a threat that will grow with complacency or increases in traffic unless due consideration is given either to the magnitude of the threat or the prevention strategies currently available such as predictive windshear radar.

Other meteorological threats that exist in Australia include severe rain, turbulence, in-flight icing and dust storms. Their frequency may be lower than in other countries which may minimise the hazard, but once again, a lack of incidence can also lead to either a complacency that there is no significant threat, or problems that stem from a lack of operational experience.

Both Qantas and Ansett are involved in International operations which means that by definition, half of these landings and take-offs are at overseas ports. These include aerodromes in all climates. Once again, long distance flights may mean that conditions are experienced at take-off in a fully laden aircraft or at the end of an long sector where the performance of the aircraft or aircrew respectively may be degraded. Heavy crewing and flight time limitations may mean that pilots are only manually landing aircraft once or twice in a month. The potential is for extreme weather conditions, an unfamiliar crew with relatively low currency on hand-flying an aircraft and a heavy aircraft. Whilst such a threat may be counteracted to a degree by the extra alertness level afforded by unfamiliarity, it should be recognised as a threat which can be counteracted through training.

Although flat terrain is repeatedly cited as a positive attribute of the Australian environment, it does not mean that relief around airports is insignificant. Controlled Flight into Terrain (CFIT) accidents often occur around airports and not necessarily because of high relief.

The so called 'tyranny of distance' experienced both in terms of interstate and international operations has, historically, been a prime motivator for demanding reliability. Alternate landing sites in remote areas are rare and early pioneers often fell foul of a lack of ground support. Had the potential for aviation during the early 20th Century not been realised then Australia would have been left behind by its traditional trading partners because of the huge distances involved and lack of alternative transportation networks. Even now the importance of air travel for international trade to and from Australia is huge. Add to this the practical issues of aircraft operating long sectors at high load factors and it is clear that modern aircraft are pushed to the limits of their operating envelopes.

Human Environment

The more recent trend in aviation safety seems to have been in highlighting the fallibility of the human environment. Indeed, there is human error to be found in every accident[8], even though many texts seem to cite a figure of around 70%. Human error is inherent in aviation as it is in any system involving human input. Whilst understanding of human frailties at both physiological and psychological levels has advanced significantly, it remains a relatively soft and often controversial area of science. For many, it represents the final frontier in conquering safety issues, yet it remains poorly understood and the source of many heated arguments.

The traditional approach to human fallibility has been one of removing the 'blameworthy' individual; a fact which is reflected in numerous accident investigations. Yet, the same mistakes are then repeated around the world, often with catastrophic consequences. This situation seems to have been allowed to continue because of the relatively good safety record enjoyed by aviation. In the event of a fatal crash, it is usually the flight crew that are killed first which has made 'pilot error' a convenient way of closing cases of human error. The more recent trend towards understanding multiple causal factors in terms of latent defects and active failures[9,10] (which may go right back to management decision making, recruitment or systems design) have begun to challenge the traditional approach. No longer can the vagaries of human performance be placed in the 'too hard basket' or blamed on errant personalities.

At a conceptual level, the essence of human error is the process of risk perception and risk taking. Decision making, which is at the heart of human behavior is based upon assessing hazards and countermeasures to achieve an outcome which is deemed to be of acceptable risk. Individuals rarely make risk taking decisions that they believe will have an outcome with an unacceptable cost (whether it be financial or physical). Instead they perceive an outcome where benefits outweigh costs. However, the process is often affected by incomplete knowledge of the nature of the risks or the effectiveness of countermeasures. Risk taking decisions are not always obvious as being such; one of the reasons why some risks are underestimated. For example, even hesitating over a decision is a risk taking decision process in itself.

Decision making occurs not just at the level of individuals, but right through to organisational levels where corporate culture can strongly impact upon risk taking decisions. Deficient organisational cultures will negatively influence the decision making skills of its employees. Similarly, leadership which focuses on short term objectives will send signals to the line workers. Organisational behavior becomes self perpetuating and entire safety cultures can be damaged to the point of an accident. Examples from within the Australian aviation system of poor safety cultures, especially in the General Aviation and Charter sectors are plentiful[11,12] and provide an early warning of a potential attitude shift within the entire industry culture if not checked.

Another, more specific corporate hazard is the process of change; something which is particularly prevalent in a dynamic, high technology industry such as aviation. The Australian aviation industry has undergone significant structural change, especially during the last ten years. The regulator has changed both its identity and the way its operating income is funded, the 'two airline policy' of domestic regulation ended, Qantas absorbed Australian Airlines before being publicly floated and Ansett became an international carrier. Whilst change in itself is not inherently dangerous, it does have the potential to result in operator unfamiliarity and unforeseen hazards.

A significant aspect of change within the Australian aviation industry has been the role of the Government. Whilst the ending of Domestic 'two airline policy' regulation was aimed at opening the system to free market forces, the playing field for new carriers was far from even. Both Ansett and Australian Airlines had massive infrastructure bases, owning not only the equipment directly associated with airline operations, but also a network of support services including travel agents, airport terminals and holiday resorts. The attempts of new carriers failed, but at the same time seriously denting the profitability of the existing carriers. The merger of Qantas and Australian airlines created a very different operation, forcing Ansett to establish international partnerships and start overseas operations.

Meanwhile, changes within the Civil Aviation Authority (CAA) were precipitated by a high level of political intervention, especially following an apparent decline in commuterline safety. The creation of a Government Business Enterprise that was responsible for making its own revenue and maintaining safety surveillance was fundamentally flawed and led to the creation of Airservices Australia and the Civil Aviation Safety Authority (CASA). Even following this restructuring, the former has been placed under considerable political pressure on the subjects of Noise Pollution and 'Airspace 2000' and the latter on the subject of Board membership. Turbulent times within the industry, further hampered by party political agendas have created the risk of both individuals and corporations missing the most important safety issues.

An unusual hazard which seems indicative of current attitude is that of 'luck belief'. Frequently cited as anecdotal evidence from expert witnesses and a perceptions survey, the explanation of good safety being a function of luck raises two concerns. Firstly, such a belief indicates a lack of understanding of the complex safety system that has worked well so far; secondly a genuine belief in a mystic force beyond human control. A poor understanding of systemic safety can lead to ill advised changes whilst belief in a force beyond human control may lead either to complacency (belief in good luck) or a form of fatalism (belief in bad luck).

Operational Environment

Within the operational environment, there are numerous technological hazards. Whilst in the strict sense, these may all ultimately be the result of human deficiencies, they are

highlighted as failure sources which are specific to certain types of operation within the aviation environment. In terms of the aircraft which are operated, there is always a threat of unforeseen problems which may be overlooked because of system complexity or opacity. These include deficiencies associated with certain types of aircraft such as the DC10 rear cargo door or more general problems associated with major leaps in technology such as the introduction of jet and fly-by-wire aircraft. The Australian environment is not immune to such problems.

Some of the other technological problems, which may not be specific to particular aircraft types, stem from the condition of the aircraft. The continued airworthiness of any design is highly dependent on maintenance and the quality control which regulates it. Whilst many maintenance failures are not catastrophic, they can induce subsequent errors by flight crew. The lower the number of failures, the less the need to rely upon the last line of defence. The quality of maintenance is controlled both internally, through quality assurance, and externally, through the regulator. Poor surveillance by either party can combine with a lack of vigilance by the other with potentially disastrous consequences.

The quality of aerodrome facilities can also be critical, especially when aircraft are operating near the limits of their performance envelope. In Australia, an example may be RPT aircraft operating at regional airports with meagre facilities. Overseas, an example may be Australian aircraft operating at airports in marginal conditions, when heavy or at the end of long sectors. Other hazards around the aerodrome include ramp accidents and those involving incorrect loading of aircraft. This may be a function of ground staff not directly employed by the airlines or involved in the servicing of a particular aircraft.

Another external agency which is part of ensuring the safety of the aviation system is the air traffic control provider. In the course of an international flight, an aircraft may pass through numerous control providers of varying standards. The risk of mid-air collision or impact with high terrain is especially significant as the results are generally severe (i.e. 100% fatalities). Complicated or poorly understood approach procedures, especially at airports without precision approaches (which is most of the domestic aerodromes in Australia other than capital cities) are a particular threat when combined with other human factors considerations. For example, communication problems, especially associated with different cultures and native tongues are a major threat to any international operation.

Security threats to aircraft, particularly in terms of terrorism, hijack or military action have accounted for a significant loss of life, although it is a fact which is generally excluded from safety statistics. Nevertheless, security incidents are generally high profile and significantly affect the perceived safety record of the carriers involved. Whilst operators are often targeted because of their nationality, they can also be selected at random which therefore makes security threats a universal hazard.

The risk countermeasures of the system

Risk countermeasures which exist to maintain a good record for airline safety occur both by design and by virtue of the systems that aviation operates within. In other words, countermeasures may be a function of the natural environment; where Australian aviation operates or the human designed operating environment or the wider human environment in which that works.

Natural Environment

The natural environment represents a relatively stable variable which allows safety systems to be constructed around it. Weather is mostly predictable within climatic zones and physical geography is generally unchanging except within the built environment. Anecdotal evidence points to 'good aviation weather' in terms of generally stable flying conditions and lack of ground icing. Certainly operations do not experience some of the extremes of North America and Europe, affording an extra risk countermeasure in normal operations. Even when weather is poor in Australia, the large RPT carriers use advanced weather radar and use extra facilities of the Bureau of Meteorology through subsidy. Additional factors include a high collective level of experience which is afforded by the major airlines and the relatively small route network. Also, a lower level of commercial pressure may reasonably be expected to assert less pressure upon flight crews to operate in marginal conditions.

The relatively flat terrain reduces the need for 'hot and high' performance critical operations and those involving complex approaches or

departures over inhospitable terrain. It also reduces the need to fly through icing levels and has an impact upon general weather conditions.

The 'tyranny of distance' also had a significant positive impact upon the early history of aviation. Hazards associated with the distances and lack of settlement demanded solutions which led to the establishment of an industry level culture of reliability and innovation. Whilst advances in technology have changed the operating environment there are many aspects of the original culture that have remained as expectations and common practice. For example, cross-checking by Second Officers even when not specifically instructed by standard operating procedures (SOPs).

Human Environment

Whilst the role of human designers, decision makers and operators are most often mentioned with regard to error and the fallibility of socio-technical systems, the human factor also represents the strongest element. Any successful defence against system failure has a human component associated with it. This is primarily a function of the unique ability of humans to evaluate consequences and rationalise in decision making, exceeding any computational power currently available. Although human strengths and weaknesses can be seen to vary between individual, common elements may be highlighted as cultural traits. Ranging from workgroup and organisational levels to professional, industry and national levels, culture is the biggest single influence on human behavior and therefore one of the most powerful influences on risk taking decisions.

Cultural strengths highlighted at national level in Australia include a high degree of individualism and a shallow authority gradient. In turn this has engendered a frank and open style of communication at both micro and macro levels. This makes cross-checking easier and facilitates the more efficient exchange of safety information. At an industry level, this is complemented by a culture of strict adherence to standard operational procedures, a fact which has often been overlooked in previous studies of the Australian culture. There is a great historical pride in the Australian aviation industry, supported by a 'Pioneer spirit' which has been forced by the geographically disparate location.

The culture of the aviation industry is also sustained through the expectations of the general public and Government. Safe operations have become an expectation in a country that is highly dependent upon aviation for intrastate and international travel. Such expectations have a secondary effect on the allocation of resources and the priority of safety on the political agenda. Recent problems at commuterline level attracted a disproportionate level of attention which have assured a high level reaction to regain a level of acceptable risk by Australian standards.

At a corporate and industry level, one of the frontline strategies in ensuring that decision making is enhanced is training; something which exists at both a structured, but thus far limited, academic level and a less formal 'lead by example' level. Airlines have long since placed strong emphasis on the integrity of training for all disciplines. Formal education is supplemented by a generally high level of experience and the strength of corporate culture in setting, communicating and enforcing standards. Communications systems and styles which facilitate this process have also allowed easier introduction of industry-standard safety strategies such as Crew Resource Management (CRM), Flight Data Analysis and Ground Proximity Warning Systems (GPWS).

The structure of Australia's aviation industry is very different to that of other nations of a similar size. In an area of land approximately the same as continental USA resides a small fraction of the equivalent population. There were two major domestic carriers and one international carrier with Qantas now being a combination of both. This situation was largely because of Government policy which limited competition on the domestic network to two airlines and made Qantas an entirely international carrier. As such, competition was severely limited which arguably led to a high level of economic stability. This allowed safety minded operators to exist without the pressures of lower quality predatory competitors, a situation quite different from the deregulated US industry. The deregulation of the Australian domestic market has not seen any long-term competitors appear on the scene. However, the absorption of Australian Airlines into Qantas and subsequent public floatation has seen pressures both overseas and especially on Ansett Australia. A lack of experience with international operations was one of the latent defects in Ansett behind the B747 VH-INH incident at Sydney in 1994[13].

However, the ability of the industry to learn from mistakes, particularly those made by others is another important facet of industry culture. Historically, Australia was used to looking towards its 'mother country' for a lead and then improving upon those ideas. There is no loss of face experienced within Australian carriers looking at what others do in an attempt to assure best practice. Expertise is drawn from throughout the world to supplement home grown skills.

Operational Environment

On more specific issues relating to the Operational Environment, strengths are numerous and centre around the medium of the aviation system; the aircraft. Whilst the number of large commercial jet aircraft manufacturers around the world is small and therefore companies such as Boeing or Airbus supply aircraft to most large airlines, there are some important differences in design. A long standing demand for reliability meant that aircraft selection and specification was extremely cautious. Aircraft with checkered histories such as the DH Comet were rejected for more conservative strategies, and successful designs often required significant modification to be accepted by both the regulator and operators.

Maintenance has always been a high profile area within the Australian system, not least because of the background of its pioneers and, again, the critical need for reliability. The quality of maintenance within Australia is recognised globally. It is supported by the cultural factors mentioned above and comprehensive training. Buyer specified equipment on aircraft supplements the margins of safety afforded by the basic design and includes such things as TCAS, QARs and defibrillators.

Regulation within the Australian aviation system has traditionally been strong and conservative, although recent crises of confidence appear to have rocked the CAA and then CASA to their collective cores. Historically, the regulator was an organisation with a great deal of operational expertise which was therefore better able to work with the industry. A more recent shift towards making politically motivated appointments has raised many questions about the ability of the regulator to effectively do its job. However, whilst this is of grave concern in the lower levels of the industry such as General Aviation and Commuterline operations, it appears not to have damaged the airlines which have evolved into largely self-regulating bodies by following JAA and FAA best practice and assisting CASA in setting standards.

Aerodrome quality was a difficult variable to assess as the effect of variables such as runway length, approach aid provision and ground facilities are directly related to other factors such as prevailing weather conditions and aircraft equipment. Further, differences in regulatory requirements are designed to ensure equal levels of safety in operation, regardless of, for example, category of ILS. The main Australian airports are maintained to ICAO standards and while many airports do not have precision approach aids, this is generally balanced by other factors such as weather and crew training.

The Australian aviation system remains generally less busy than its European or US counterparts. Airports have only two ground handling organisations, both owned by the two major airlines. As a result, the ramp remains less chaotic and, thus far, a controllable hazard. However, this is a situation that may change with increased traffic and if third party ground handling agencies are introduced.

Rescue and Fire Fighting cover represents a secondary safety measure which is rarely called upon because of a lack of incidents. However, at major airports in Australia cover meets ICAO standards and benefits from being tasked solely with its core function, unlike many such organisations overseas. This provision is indicative of a culture that is not complacent about secondary safety in the light of good primary safety. This provides an additional margin of safety which may one day make a critical difference to the outcome of an incident.

Security threats in Australia were of relatively low concern because of the moderate political climate. However, airlines are always at risk of criminal activity such as hijack or bomb threats, mentally unstable individuals and other newly developing threats. Security for International operations out of Australia is at the same levels as the more highly threatened US, providing an added margin of safety which is reflected in the general lack of incidents.

The level of ATC cover at major ports is good and Australia plans to introduce the most advanced ATC system in the world (TAAATS) in 1998. Concerns that the ability to deliver a

safe air traffic management system which were raised in the late 1980s and early 1990s are being addressed through initiatives such as TAAATS and a Boardroom led commitment to improving system safety.

System reliability in general has been very high with the operational and human environments not taking the hazards of the natural environment for granted. Positive cultural factors associated with natural culture and historical challenges has helped to build a strong safety system with numerous safety margins. Open and frank communications have acted as the conduit by which a sound level of system safety health has developed and herein lies the key to a successful future.

The industry needs to recognise its strengths and build on them whilst other industries or countries try to emulate them, within their own system constraints. Open and frank observations contained within this research aim to be part of the ongoing process and not evidence to be used in a reckless or critical manner. Australia's safety record has not been the result of luck, rather the outcome of a complex, but well designed operating system.

Future threats to system safety health

Although the aim of this research was to concentrate on what Australia does right, it is not intended to give the impression that all is perfect. Safety is not a state which can be reached, it is a continuing battle against an ever changing multiplicity of threats. Those who believe they have achieved a state of 'being safe' risk falling foul of complacency.

There are a number of threats to the future of Australian aviation safety which have become apparent during the course of this work.

Economic pressure on the aviation industry is always high because of its intense capital utilisation and dependence on blue chip and service industries. In Australia's case, this has been heightened by significant structural changes undergone by the aviation industry within the last decade. These have included the ending of the two-airline policy, merger of Australian Airlines and Qantas, public flotation of Qantas, and Ansett's expansion into International operations. Cost cutting within both airlines has been significant and placed pressure on all aspects of the operation. Whilst many fear that this will directly impact upon safety, some signs point to a more integrated approach towards both safety and efficiency. Following a close call involving B747 VH-INH in 1994[13], Ansett's current business recovery strategy puts safety visibly first and includes human factors training as a core methodology to achieving efficiency and safety by working smarter, not harder.

An increase in traffic, which is predicted at approximately 6.5% will bring additional pressures to the industry, not least in its attempts to compete with in the Asia Pacific region where growth is predicted to reach up to 11%. One of the challenges will be increasing pressures on infrastructure, especially air traffic services, airports, training and maintenance. Growing pains do not have to mean a degradation of safety, but the industry must adopt sound risk assessment methodologies if it is to adequately manage the change process. Problems which may have been underestimated because of a lack of incidents may become tomorrow's accidents if not catered for. For example, aircraft making approaches or taking off in marginal weather conditions where in less busy times, this may have been avoidable.

Culture has been shown to have played an important role in the safety health of aviation and changes at any level can have an indirect effect on the future. Changes at national level may be quite slow, but in a fast developing, underpopulated country such as Australia, the effect of change should not be underestimated. Political motivations and public expectations have a significant effect on resource allocation and priorities. Issues such as noise pollution, particularly with reference to Sydney airport will put major pressure on operating efficiency.

Industry and corporate culture can usually change more quickly than national culture as events within the CAA / CASA during the 1990's have shown. Individuals, when placed in key positions, can have a significant effect on the way organisations operate. Positive examples include charismatic leaders like Herb Kelleher (Southwest) and Richard Branson (Virgin Atlantic) who have managed to assert their individual style on their organisation's operations. Negative examples are plentiful and all industries need to be aware that although accident investigation has moved on from apportioning blame to individuals, it has also shown the root of many accidents to be high level decision making at CEO or Board level.

The mid 1990's have also brought changes to the way the Australian industry is regulated. A widescale regulatory review commenced in 1997 aiming to review the entire Australian regulations and to step towards harmonisation with the FAA or JAA. The process is currently suspended in the light of another CASA reorganisation. The temptation to harmonise or follow the lead, particularly of the FAA, should, at least, pay respect to the need for cultural suitability. Regulations which may appear excessive by US or European standards may be responsible for additional safety margins and any changes should be thoroughly examined for their systemic ramifications.

Finally, there is the constant and chronic threat of complacency which is associated with any operating system that appears to be working. A lack of accidents is only a very rough guide of system safety health and in aviation, where the consequences are potentially catastrophic, not a sensible measure of current performance. The determining factors as to whether Australia manages to keep its clear record for fatal aircraft accidents do not include the past accident record. Constant evolution of the aviation environment will require adaptation of the many risk countermeasures if safety is to be maintained.

Complacency is a significant threat, not least because it can strike at the core of the strongest aspect of the Australian system, namely the human environment and in particular, the various levels of culture which have held it together successfully so far. Whilst complacency represents a mood that 'nothing needs to be done', a further threat is from a belief that 'nothing can be done'; a sort of fatalism towards factors beyond human control. The latter has been expressed by a number of witnesses as a feeling that 'Australia is due for a crash' or that the good record 'has to come to an end'. Accidents do not occur because statistics say they should and whilst a good accident record is no guarantee of future success, neither is it a bad omen.

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