

“...and on the eighth day, God created pilots”

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Introduction

In 1993, a research project at Loughborough University in the UK set out to examine the reasons behind Australia's apparently good record for airline safety. The conclusions point to a multiplicity of influences that range from hard engineering factors such as aircraft selection policy and a refusal to carry-over minimum equipment list (MEL) failures, to softer, human factors issues such as the influence of national and corporate culture upon communications and risk taking. This paper documents some of those research findings and highlights the next step in learning the lessons from that work and new research that is being conducted at the University of New South Wales in Sydney.

Acceptable Safety

The notion of 'affordable safety' seems to bring shivers to the collective spines of professional aviators throughout Australia. This is probably largely a function of the man who first popularised the phrase and his interpretation of it. In fact, the whole concept of safety *is* based upon affordability, that is the point at which we consider certain risks to be acceptable. Safety is not measurable; risks are measured. Safety may be judged relative to its level of risk versus the acceptable level of risk. To determine safety therefore, involves two quite separate activities; measuring risk and judging safety i.e. the acceptability of risks. It is therefore vital to reconcile the term safety with risk.

The acceptability of risk is not the same as the elimination of it. We all accept risks as part of daily life and if we did not do so then we would probably soon die of dehydration or starvation. The crucial factors that set skydiving grannies apart from those who sit crocheting socks and, moreover, those which appear to separate certain political aviators from the average airline pilots, seem to be the level of acceptable risk. What is most important to the integrity of the aviation industry is that the decision makers, at whatever level are armed with an accurate perception of risk acceptability. Slovic, Fischhoff and Lichtenstein (1980) note that "people respond to the hazards they perceive" and consequently if these "...perceptions are faulty, efforts at public and environmental protection are likely to be misdirected."

To suggest that the majority of air transport accidents have been the result of 'faulty risk perceptions' or poor risk-taking decisions may seem to be a somewhat inflammatory remark at first glance. Surely no-one ever 'takes risks' in safety critical situations? But of course, everyone does take such risk-taking decisions as a matter of routine. Take as an example, the much publicised crash involving B737-400 G-OBME at Kegworth, UK in January 1990. The aircraft had developed an in-flight defect in one of its two engines and the crew shut down what they thought was the damaged engine. (In fact they had selected the wrong engine.) A diversion was made to East Midlands Airport (which happened to be

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the airline maintenance base) and upon final approach, the single remaining running engine broke up. The aircraft collided with terrain short of the runway threshold with the loss of 57 souls. The risk-taking decisions which may now be seen to have been faulty in that incident include:

Decision	Made by?
• Are two-engined aircraft safe for passenger transport?	(regulator)
• Is the 737-400 a reliable and safe aircraft?	(regulator / airline)
• Were the crew adequately trained to be released to the line?	(airline)
• Were the crew confident enough in their ability to detect faults?	(crew)
• Was the aircraft warning system adequate for fault detection?	(manufacturer)
• Was the engine of adequate design?	(manufacturer)
• Did the errant engine need to be shut down immediately?	(crew)
• Should the crew have made a visual inspection in flight?	(crew)
• Was a diversion to the nearest airfield (Birmingham) necessary?	(crew)
• Should passengers / cabin crew questioned the PA announcement?	(pax / crew)

These are similar to Reason's 'fallible decisions' (Reason, 1990) and yet, it is important to note that these are all specifically risk-taking decisions. Some are relatively subliminal or subconscious such as the passengers' decision not to question a public address made by the flight crew explaining that the engine which had been shut down was the opposite to the one they had seen flames emanating from. In rationalising the statement, passengers may have dismissed the substitution of left for right as a slip of the tongue or assumed that the engines were named facing backwards rather than forwards, but they will have all made a decision about whether their safety was to be affected by them not questioning what was said. This is not to suggest that such a reaction is anything other than the same process that we would all go through if placed in similar circumstances. The risk perception of the average passenger is that flight crew know left from right - no need to intervene...

Risk Taking and Authority

One of the principle aims of crew resource management (CRM) type training is to improve safety by enhancing the communication process. (In most accidents, there are individuals who held crucial information which, if communicated to the right person, may have prevented the occurrence.) It is suggested that one of Australia's greatest aviation assets on the flight deck is an openness in communication. A lowly Second Officer is able (if not expected) to speak up, even if the most senior Check Captain is making an error, and while there may be exceptions to this rule, this makes the introduction of CRM principles easier than in certain other cultures.

So what has CRM training, or an enhanced ability to communicate, got to do with risk taking? The more information we have to make risk-taking decisions with, the better chance we have of getting things right. If we train pilots in the 'right stuff' tradition then they limit themselves in the amount of information that can be made available to them to make risk taking decisions. This may seem very obvious, but it is becoming easy to forget what we are really trying to achieve with CRM training. Simply paying lip-service to it is not enough; the purpose is not simply to make aircraft happier, friendlier places to work, it is to enhance critical, safety-related, decision making.

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Students within the University of New South Wales Department of Aviation are currently studying for a Bachelor of aviation (BAv) degree which may include flight training from zero hours to CPL standard or a focus on Operations Management. As this is a relatively new programme, the first graduates will leave at the end of 1997. What is unusual, is the emphasis placed on crew resource management as a core component in the degree syllabus.

Early in the history of the degree programme, the basic question was asked; *If CRM training is such a good thing for pilots to do at airline level, then why are we waiting until they get this far?*

Once flight crew get to an airline, they will undertake a conversion training course in an attempt to alter the way certain individuals behave and while it has been shown that 'old dogs' can be taught new tricks, it seems fundamentally wrong that basic concepts of airmanship (command, co-ordination and communication) are being trained as a fixing patch later in a pilots career (assuming they ever get this far!).

UNSW aviation students are encouraged to treat CRM as 'Colleague Resource Management' which is a subtle, yet important variation on the traditional theme. It is rather more than an excursion into semantics, it represents the step that CRM needed to make - that is to extend the team concept beyond the flight deck, and even beyond the aircraft, to incorporate the true team involved in the safe operation of an aircraft. In the case of our students this means incorporating the resources of the flying instructor, Flight Standards Officer and air traffic controller to name but three. CRM is no longer a separate component of training that comes late into pilots' careers, it represents an operating philosophy on which all other training is built.

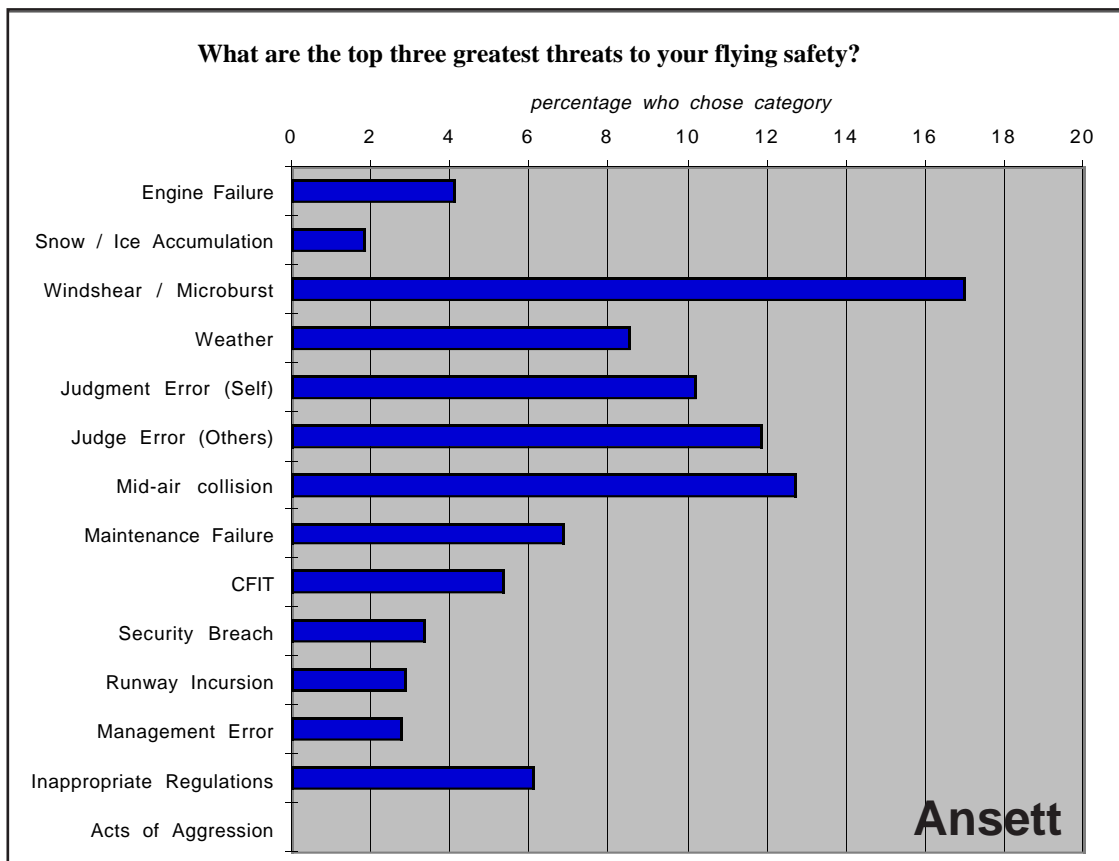
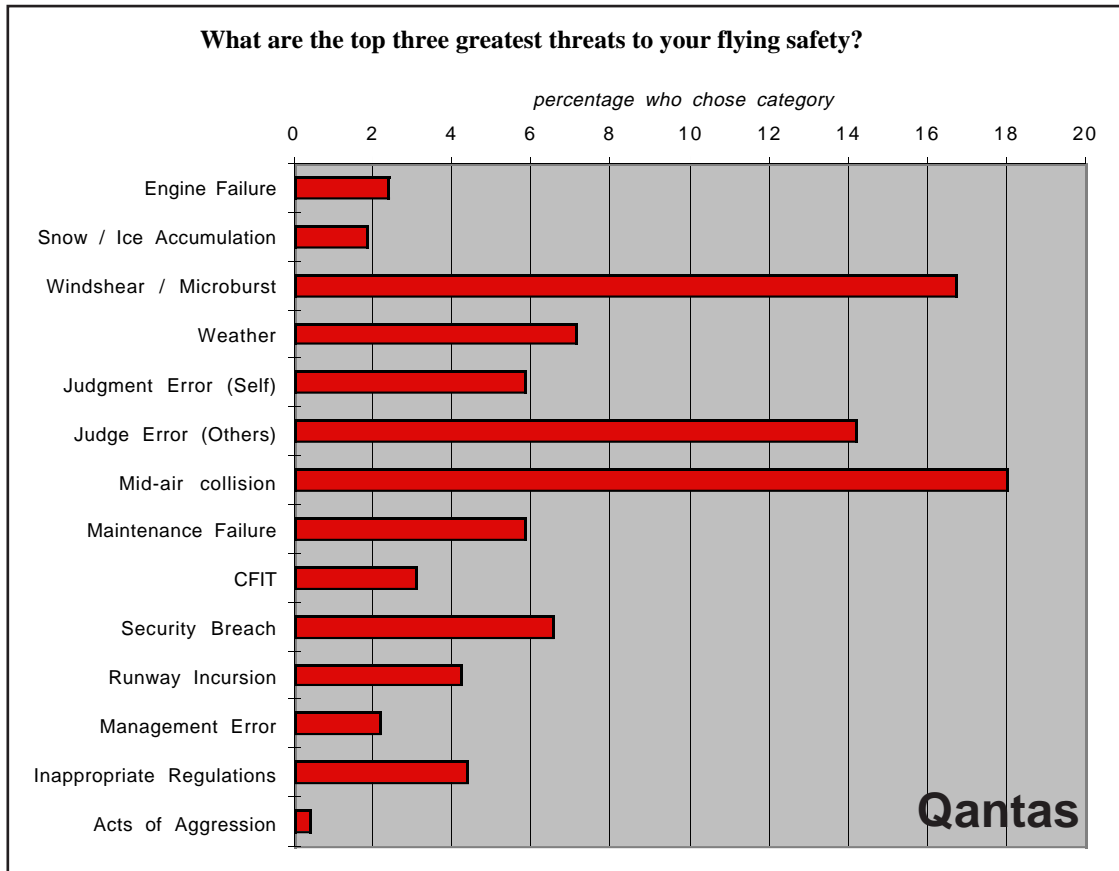
One of the objectives of *ab initio* training is to develop airmanship or instinctive behaviour that will see a pilot safely through their career. We are hopefully doing just that and extending the realms of CRM acceptability to a point where it is no longer an 'add-on' to qualified pilots' training but as much a part of basic flight training as, say, meteorology or aerodynamics.

But is such a focus on CRM issues really warranted? While there are few people in the industry that would dare to suggest that CRM has no benefit, it is near impossible to measure the benefits of different components of training courses or whether it has improved the performance of individual crew members. Indeed, it is possible that certain aspects of CRM actually have a negative effect on crew members. For example, there is evidence that certain airlines are suffering from insubordination on the flight deck from First Officers who have an over-zealous feeling of empowerment following CRM training. (CRM Developers Group, 1997). What is beyond doubt is that the overruling principles of efficient and effective communications are capable of making continued, significant inroads into the accident record.

Although Australia's fatality toll for commercial jet RPT (regular passenger transport) operations remains at the enviable total of zero, it will only stay so with a significant effort in recognising and eliminating hazards. The new emphasis on human factors and CRM training at *ab initio* level represents an attempt to create long term solutions for the professional pilots of tomorrow.

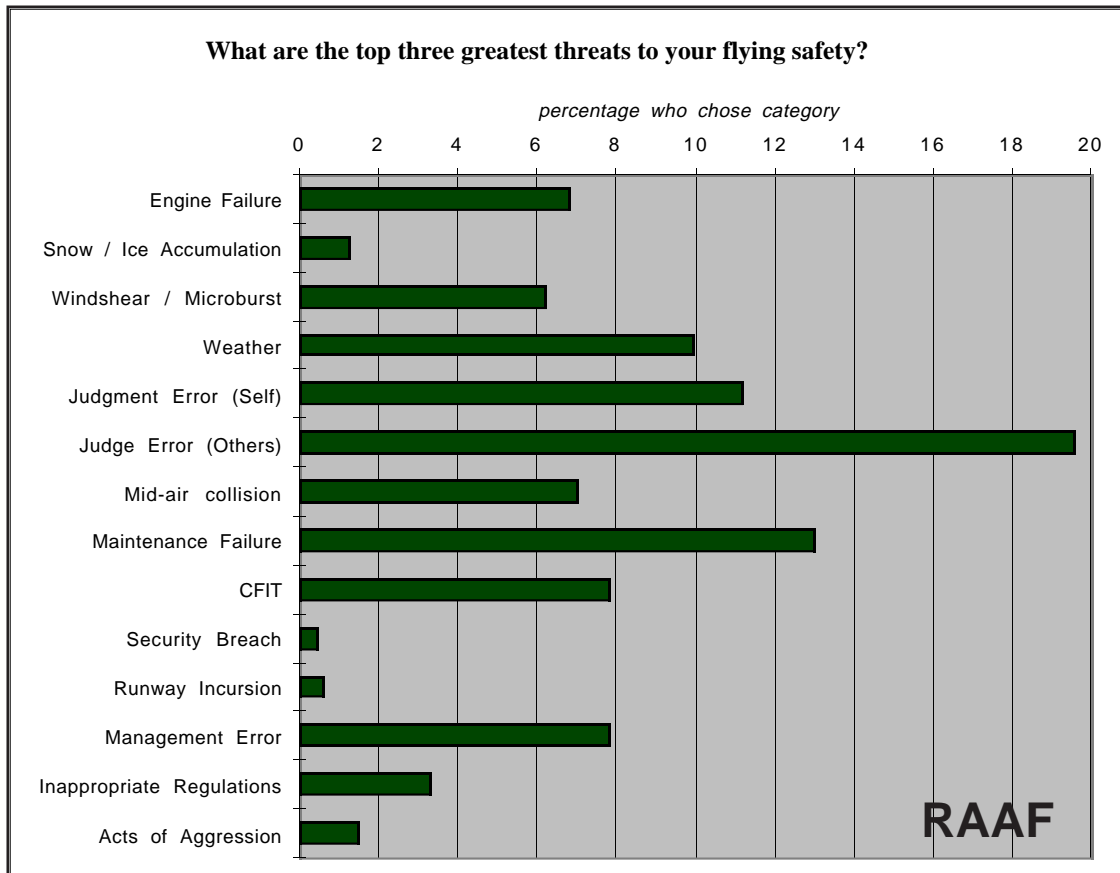
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As part of Loughborough University's work, Australian flight crews were asked what they considered to be the greatest threat to their flying safety. Requested to specify the three factors that concerned them the most, these were the responses;

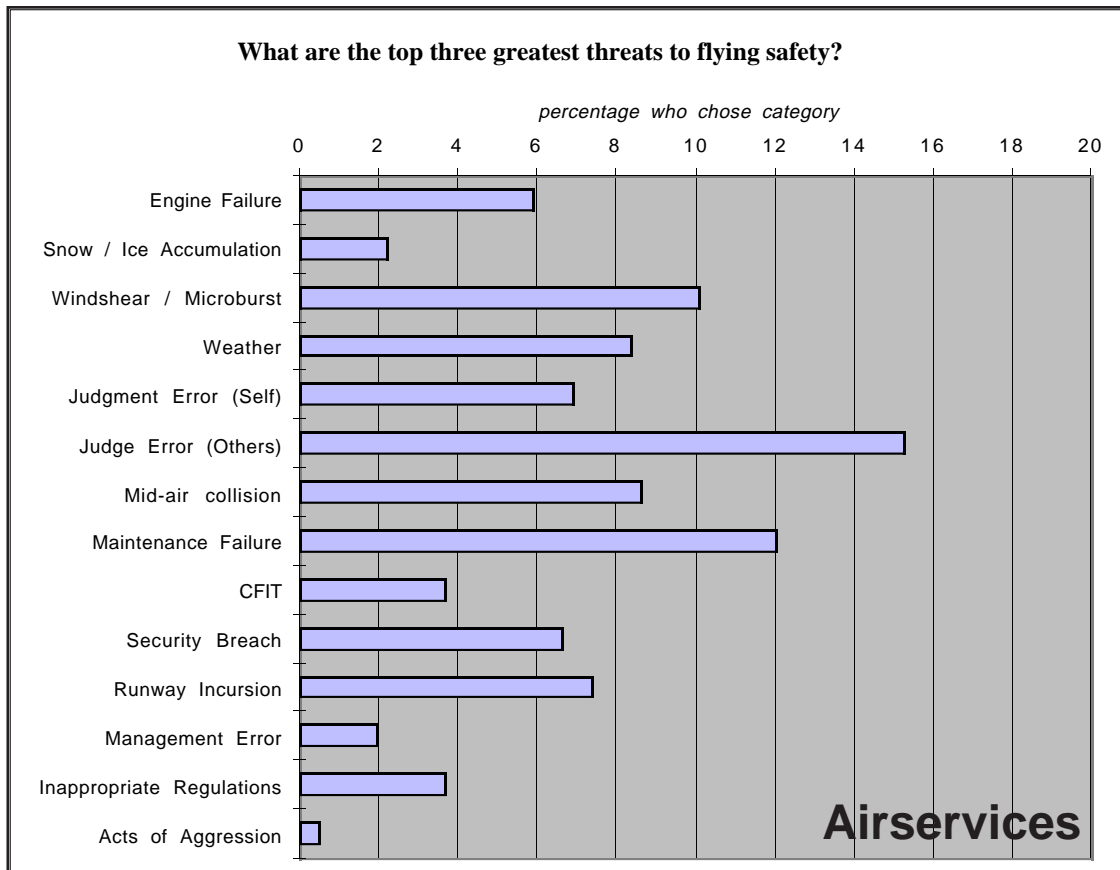


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The RAAF Transport aircraft crews answered as follows;



The civilian air traffic controllers asked a slightly different question as follows;



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While there are a number of notable differences in the responses between the four groups (enough for a separate paper!), there are a few similarities which are worth commenting on in the context of this paper.

Firstly, although the highest ranking factors seem to be quite diverse (microburst, mid-air collision, judgment error and maintenance failure), they all have solutions (or defences) which are human factors based. Before the pilots amongst us faint at the suggestion that the solution to the threat of a windshear/microburst accident is human factors related, let me try and explain: In many of the areas mentioned, the effective and efficient flow of information will provide barriers to Reason's 'windows of opportunity' (Reason, 1992) and prevent an accident. For example,

Avoidance of microburst / windshear encounters

Who may hold the vital information?

- Meteorological forecasting
- ATC Tower Observations
- Previous Aircraft Observations
- Non-Flying Pilot's Observations
- Airline Training Staff
- Research Institutions

Example 1

Avoidance of mid-air collisions

Who may hold the vital information?

- Air Traffic Control
- Other Aircraft
- Non-Flying Pilot / Flight Engineer
- TCAS Equipment
- Airline Training Staff
- Research Institutions

Example 2

Some of you may consider parts of those answers to be a little odd: How on earth can a research institution or even airline training staff help you while you are up there flying into a storm or playing Russian roulette with deficient air traffic control? Surely when you are up there you are on your own? The answer is, of course, no - you are never alone. Flight training has the opportunity to include extended resources, such as the results of academic research, as long as the aviation community can accept the concept of crew resources being rather more than those on the aircraft.

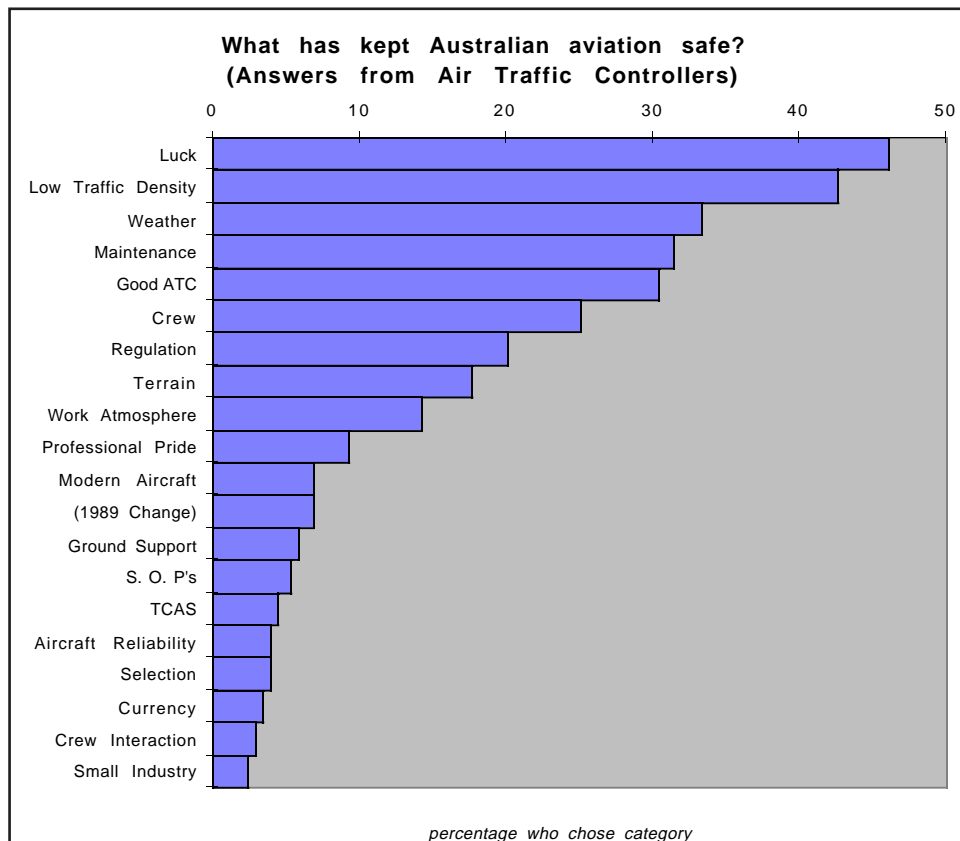
Complaints from flight crews, voiced throughout our research, include comments regarding intensified commercial pressure and unreasonable expectations from managers or the commercial arm of the airline. This comes as no great surprise, but different carriers have different methods of curing (or ignoring!) the problems. Increasing our student pilots' awareness of what resources are available to them and how best to approach them is one,

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longer term solution. Training our non-flying Operations Management stream (arguably the managers of tomorrow,) in full crew resource management is another way of spreading the message to a wider audience than well seasoned pilots taken from the line for their annual fix of CRM. Experience with the setting up and running of Britannia Airways' Integrated CRM Training in 1996 revealed that one of the most talked about features of the entire course was that the Managing Director had actually done the course with the line crew. The fact that management were prepared to come along and 'muck in' with the underlings grossly enhanced both their credibility and that of the course.

Nevertheless, the spirit of the right stuff lives on in the attitudes of so many involved in aviation. Some of the recent arguments regarding the make-up of the CASA Board in Australia focussed on a lack of aviation experience. The view that an executive board can only be effectively filled with experienced aviators is as extreme as the view of airline pilots as 'glorified bus drivers'. The aviation community knows what makes aircraft crash, but is the right information being communicated to the right people? Is this drifting away from being a paper about crew resource management? I think not.

False perceptions about what makes aviation safe affect the way that individuals accept risk in the future. For example, if we accept the view of air traffic controllers that Australia's good safety record has been achieved primarily through luck (see figure below) then we risk the industry becoming fatalistic in its approach. Will the sequel of Rain Man really have Dustin Hoffman's character protesting that he will only fly with Qantas because "...Qantas never crash", only to be silenced by Tom Cruise saying, "but statistically they are due for one so let's fly with TWA instead!". I can't see it myself, but there were enough questionnaire responses to the effect that there are bound to be fatalities in the future in Australia because of statistical probability, for it to be a real concern. No aircraft has ever crashed because of statistics!



Conclusions

Safety is assured by balancing risk exposure to risk countermeasures at a point where risks are judged to be acceptable. This process suffers from a lack of complete information and is therefore high dependent on risk perception. Arguably, attempts to improve the accuracy of the risk perception process can have a significant effect on the safety process.

If aviation allows mistaken perceptions to continue, either through misconception or lack of information, then we are not fully using the resources that are available to us. For example, the belief that Australia's safety record has been assured solely through good luck or even good weather, low terrain and low traffic density is dangerously faulted. It is these simplistic beliefs that have led to a number of the fallible decisions that have caused recent accidents in Australia. The complacent notion that 'she'll be right' is partly based on the negligent propagation of the great Aussie myth about what makes aviation safe. Unless significant progress is made in the human areas of risk taking and resource utilisation, there will be a big accident in Australia - an accident that can still be avoided.

Initiatives such as UNSW's emphasis on *ab initio* CRM represent one of the opportunities to create long term, systemic solutions. The reactions of the military, airlines and Airservices to the results of the Loughborough University attitudes survey represent an opportunity to learn from easy mistakes before we have to learn from the hard ones.

The message for the 21st Century is simple - we need to do better to stay where we are. Crew Resource Management training for flight crew is not enough to keep us from accidents but its underlying principle of efficient and effective communications might well be. There are no new accidents - only variations on a theme, so is the industry really doing all it can to learn from past mistakes?

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