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# Identifying and Responding to Warnings: The Case of Australia's Air Traffic Control Organisation

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An earlier paper in this series demonstrated that one of the most distinctive things about high reliability organisations (HROs) is that they are alert to warnings of danger, that they have highly developed systems for picking up these warning signs and, of course, that they react effectively to these warnings. This paper will examine how one organisation that aspires to HRO status puts this into practice. That organisation is Airservices Australia, Australia's air navigation service provider. The focus of the chapter is the reporting system or systems that Airservices operates.

Safety reporting systems differ across industries and enterprises. In some environments reporting systems focus on injuries occurring to the workforce. The number of injuries is used as an indicator of the safety performance of the company or industry: the lower the number of incidents the better. However, individual injury rates tell us nothing about how well major hazards are being managed. It is quite possible for enterprises to drive their annual injury rate to zero and remain at risk of a major accident, as is well demonstrated by accidents such the Longford gas plant explosion near Melbourne in 1998[1]

Where an industry or company is trying to use its reporting system as an early warning system, it will encourage the reporting of occurrences that, while not themselves involving injury or damage, reveal that certain hazards are not adequately under control. In contrast to simple injury reporting systems, there is a sense in which the more hazard and occurrence reports there are, the better[2].

Although the reporting of warning signs is vital for accident prevention, employees in organisations where such reporting systems exist are seldom given much guidance on the types of hazards and occurrences that represent the most significance precursors to injury in their environment. In short, seldom are they given guidance on what to report.

The aviation industry departs dramatically from this pattern. The industry has a relatively well developed idea of the precursor events that are worthy of reporting, and detailed guidance is provided on what to report. Indeed, Australian government legislation spells out a number of things that must be reported to the Australian Transport Safety Bureau[3]. For instance, whenever an aircraft moves without authorization onto a runway that is in use (a runway incursion) this must be reported. Or again, when two aircraft under air traffic control pass within less than a specified distance of each other in controlled airspace (a breakdown of separation), a report must be made to the Australian Transport Safety Bureau.

Partly in response to these legislatively prescribed reporting requirements, Airservices and all the major airlines, maintain their own, reporting systems and provide guidance to their employees about what to report. The Airservices "safety incident" reporting system specifies a list of eighteen "immediately reportable matters" that includes runway incursions, breakdown of separation, difficulty experienced by a pilot in controlling aircraft, failure to achieve expected performance during takeoff and landing, and so on. There is second list of sixteen "routinely reportable matters" that are judged to be less urgent but that nevertheless have the potential to affect safety, and must also be entered into same the incident reporting system. This list includes matters such as a pilot's failure to comply with instructions from air traffic controllers, and failure to pass on information. These lists cover the matters that by law must be reported to the Australian Transport Safety Bureau, but they are tailored to Airservices' particular circumstances so as to maximize the accident prevention potential of its reporting system. Airservices does not intend these lists to be exhaustive and staff are encouraged to report other matters if they believe they may have impacted on safety[4].

Apart from an incident reporting system oriented towards compliance with legislative requirements, Airservices maintains several other reporting systems, all designed to pick up problems before they result in harmful outcomes. Two of these will be mentioned here. The first is a so-called "event reporting system". According to Airservices, this "is intended to encourage Airservices Australia staff to report an event which it is felt does not come within the meaning of an incident yet early reporting of the information may be useful in controlling risks by helping Airservices Australia anticipate failures and errors".[5] The second is a system designed to allow staff to make confidential (not anonymous) reports about "safety concerns"[6]. The subtle differences in focus of these various reporting systems go a long way to ensuring that deviations, errors, and failures of various sorts will be picked up and processed.

This paper is organised as follows. First, it examines what gets reported through Airservices' main reporting systems. It also explores the reasons for Airservices' extraordinary reporting culture. The chapter moves on to consider how Airservices prioritises the incident reports it receives. Finally, the chapter examines the use that Airservices makes of these reports, for it is only if an organisation makes effective use of the reports it receives that it can reasonably claim to be a learning organisation.

## What is reported

Some sense of what is reported through the main incident reporting system can be gained by examining all reports for a randomly selected seven day period[7] (see table 1).

**Table 1**
**Incident Reports in Sample Week.**

| | *Category* | *Number of reports* |
|---|---|---|
| 1 | Violations of controlled air space | 29 |
| 2 | Potential operational deviation | 16 |
| 3 | Failure to comply with ATC instructions/procedures | 15 |
| 4 | Emergencies (such as emergency landings) | 15 |
| 5 | Birdstrike | 10 |
| 6 | Runway incursions | 8 |
| 7 | Information delivery/display error | 7 |
| 8 | Breakdown of coordination | 7 |
| 9 | Failure of Airservices navigational equipment[8] | 5 |
| 10 | Aircraft accidents | 4 |
| 11 | Go around | 4 |
| 12 | Breakdown of separation | 3 |
| 13 | TCAS resolution | 2 |
| 14 | Airprox | 1 |
| 15 | Loss of separation assurance | 1 |
| 16 | Other | 8 |

Some of these categories are self evident or have already been explained. The meaning of the others is described in what follows.

*1 Violation of controlled airspace*. Broadly speaking, the sky is divided into controlled and uncontrolled airspace. In controlled airspace pilots must fly only routes authorized by air traffic controllers, and the principal job of the air traffic controller is to ensure that aircraft remain well separated from each other. In uncontrolled air space, pilots may fly where they wish, relying on their own resources to avoid collisions. Generally speaking, high altitude airspace is controlled and, space nearer the ground is uncontrolled, except in the vicinity of the larger airports, where controlled space comes down to ground level. This means that airliners on major routes may fly in controlled airspace at all times. It also means that small aircraft, provided they stay away from large airports and fly at low altitude, can fly in uncontrolled airspace the whole time. Aircraft that fly in controlled airspace must pay for the privilege and must and register their flight plans with the controllers. Small aircraft operators generally prefer to fly in uncontrolled airspace to avoid these requirements. However, small aircraft sometimes stray into controlled airspace by accident. This is a violation of controlled airspace and most violations of controlled airspace are of this type.

*2 Potential operational deviation.* These are usually either errors by air traffic control, or pilot errors. After investigation they are assigned into one or other of these categories (see categories 3 and 8 below). The incidents remaining in this classification are matters that have not been resolved.

3 *Failure to comply with ATC(air traffic control) instructions/procedures* . Almost invariably these are failures by pilots.

*7 Information delivery/display error.* Cases where either air traffic controllers or pilots have not delivered or displayed the correct or appropriate information.

*8 Breakdown of coordination.* These are situations in which information supplied to pilots by ATC is deficient in some way - delayed, incomplete, absent or incorrect.

*10 Aircraft accidents.* The four accidents in the sample period included a light and an ultralight aircraft crash, one collapsed nosewheel landing and one scraped engine landing (Most aircraft accidents have nothing to do with ATC.)

*11 Go around.* This is when an aircraft that is approaching a runway aborts the landing and goes around for another attempt. This may be as a result of an instruction from ATC or as a result of the pilot's own decision.

*13 TCAS resolution.* Modern passenger aircraft are equipped with a "traffic advisory and collision avoidance system" (TCAS). When the system detects that the aircraft is on a potential collision course with another aircraft it sounds a warning. Pilots may then need to change course to avoid a collision. Such an outcome is referred to as a TCAS resolution.

*14 Airprox.* When two aircraft that are *not under air traffic control* come too close for safety.

*15 Loss of separation assurance.*These are cases in which ATC was not effectively monitoring separation, as it should have been, but proper separation was nevertheless maintained.

This last category is not specified by government regulations and is a very clear example of lengths to which Airservices goes to pick up precursor events. Airservices' objective is to maintain at all times a specified minimum distance between aircraft under its control. Incidents in this last category involve no loss of separation, and therefore no danger. It is simply that for some period of time Airservices failed to monitor aircraft separation and hence was not in a position to provide *assurance* that aircraft were appropriately separated. There are various reasons why this might have happened, and investigating reports of this nature enables Airservices to improve the reliability of service. This attention to detail is characteristic of high reliability organisations.

When Airservices staff make reports they must provide a brief description of the incident and classify it into one of the categories above. In addition, in the case of incidents (not events to be discussed below) they make a preliminary judgment as to whether the incident can be attributed to an air traffic controller, an aircraft pilot or some other source. These attributions are checked by the line manager. In the sample week, 12 per cent of  reported incidents were attributed to Airservices air traffic controllers, while 54 per cent were attributed to pilots.

**Event reporting**

I turn now to the second reporting system, designed to capture *events* that do not fit into the categories of the incident reporting system but are nevertheless judged to have safety implications that make them worth recording. There were ninety events reported in the sample week. This is a rather more difficult data set to classify, indeed the largest single category is "miscellaneous", but it is worth mentioning three instances to give some indication of the breadth of what is reported.

> * As part of a weekly crash alarm exercise, ATC called the local police to pass on an "exercise scenario". The person receiving the call did not know what to do with it. The call was transferred, not once, but twice, and ATC ended up conveying the message to three different people before the police were able to respond. The delay was such that controllers thought the matter worthy of report.
>
> * A Qantas pilot advised that when he arrived at the parking bay he had been assigned at Sydney airport, it was already occupied. While it is hard to see that this incident in itself had any safety implications, it is indicative of a communication failure that might in some other circumstances have safety consequences. Controllers decided to report the incident into the Airservices event reporting system.
>
> * A passenger reported to flight crew seeing a metal object on the runway as the aircraft was departing Brisbane airport. Flight crew reported immediately to ATC, which put incoming aircraft in holding patterns, while a runway inspection was organised. A 15cm section of rubber door seal was found. This sequence of events was reported into the Airservices event reporting system.

This last incident has interesting echoes in the high reliability literature. The story is told of seaman who thought he might have left a tool on the deck of an aircraft carrier. Such was the reporting culture on this vessel that the seaman reported the matter. Several aircraft were aloft at the time and at considerable inconvenience they were diverted to a shore base until the tool was found, after which they were brought back on board. The next day the aircraft carrier commander summoned his crew for a ceremony on deck in which he praised the individual concerned for reporting his own error[9]. This story is used to demonstrate the extraordinary reporting culture to be found in HROs. The Brisbane airport story demonstrates the extraordinary nature of reporting in the airline industry in general.

These events give some indication of the diversity of matters that find their way into the Airservices event reporting system. Very few organisations capture such an array of safety relevant information.

## A culture of reporting

It is clear from the preceding description that Airservices has an active reporting culture. One piece of evidence indicates just how active this culture is. Airservices monitors the reporting behaviour of its staff in various ways, for instance by routinely listening to samples of recorded conversations between controllers and pilots, in order to discover whether there are matters that should have been reported but weren't. This monitoring reveals less than a dozen such incidents each year.

Monitoring of this nature requires dedicated resources, and the willingness of Airservices to provide these resources to ensure that its reporting system is working optimally is one of the hallmarks of a high reliability organisation.

Many industries have difficulty in getting employees to report and it is worth enumerating some of the reasons why Airservices has been so successful in this respect. First, as discussed above, Airservices audits its reporting system in various ways which reveal whether or not its controllers are reporting. Second, Airservices has specified in considerable detail things that it wants reported. Staff are not left to work out for themselves whether an event may have safety implications and therefore be worth reporting; to a considerable extent the organisation has done this for them. Third, there is the distinct possibility of discipline if people fail to report. Fourth, in many cases, reports about the incident may be made by other parties into other reporting systems. For instance, pilots may report an incident into their own airline's reporting system. This information is shared with Airservices and if an incident is of a type which should have been reported by an air traffic controller but wasn't, questions will be asked. Fifth, many of the reports by air traffic controllers attribute responsibility for an incident to an pilot, who will not be known personally to the controller, thus removing any impediments that controllers might feel about 'dobbing in a mate'.

## The survey of willingness to report

The energy which Airservices puts into maintaining this culture of reporting is extraordinary by the standards of most other industries, as is nicely illustrated by the following events. In one routinely monitored conversation, an air traffic controller was heard to say one thing when he obviously meant another. The pilot raised the matter and controller corrected himself. However, the controller did not report his error into the incident reporting system. This is the kind of error that Airservices particularly wants reported. It is an error that has not been corrected automatically within the organisation and has only been picked up because it was identified by an external party, in the case a pilot.

Two or three weeks later, routine monitoring identified a second failure to report. On this occasion, the air traffic controller had experienced problems that culminated in a collision avoidance alert sounding in one aircraft. The controller failed to report this occurrence at the end of the shift. The failure was obviously unintentional, as it was clear that the matter would have been reported through the reporting system of the airline concerned and thus come to the attention of Airservices in this way.

The Safety Management Group within Airservices noted that this was the second failure to report within a matter of weeks. It generated the sense of disquiet that is so typical of HROs. In Weick's terms, this was a weak signal requiring a strong response. The matter was raised immediately at Board level and various responses were set in motion. Most significantly, Airservices decided to carry out a study of controllers' willingness to report. Controllers are spread around Australia, some at quite small, remote airfields, and Airservices was particularly concerned about the possibility that subcultures resistant to reporting might develop at these locations. The study therefore examined reporting trends over time for different locations. It also surveyed 250 randomly selected controllers. The report found that no deviant subcultures existed and that willingness to report was high. In its words,

> "The results of the review have revealed a consistent culture which is increasing in its willingness to report breaches and failures of process or protocols. This willingness to report seemingly exists, even in the face of what may be perceived to be significant penalties, for example the threat to ongoing employment, reduction in operating unit's reputation."[10]

The most significant negative finding of the survey was that many controllers believed that the organisation was not responding to incident reports adequately and that there was inadequate feedback to the groups in which the report originated. Airservices accepted that it was not communicating adequately with reporters about lessons learnt. It is developing new techniques for providing feedback on incident reports and has employed additional staff to support this effort.

**An aside on the meaning of culture**

The preceding account provides a useful illustration of the meaning of culture in an organisational context. There are two rather different ways of thinking about organisational culture. The first sees culture as referring to the attitudes of people, while the second sees it as referring to their practices. Where the first meaning is emphasized there is a tendency to talk about "mindset"; where the second is emphasized there is a tendency to speak of culture as "the way we do things around here". These two ways of thinking about culture are of course complementary, but they do suggest different strategies when it comes to changing organisational cultures. Where culture is seen as a matter of mindset, the aim will be to change the way people think, perhaps through various educational programs. Where culture is seen as a matter of practices, organisations will seek to change practices by providing a system of incentives and disincentives. In principle, this second approach is to be preferred. It is very difficult to change what is inside someone's head, and relatively easy to change behaviour, given the right system of incentives[11]. Moreover, from a practical point of view, it doesn't matter a great deal what people think, as long as they behave in the required way.

This analysis can be seen as supportive of behavioural safety programs. However such programs are generally focused on relatively minor risks (Hopkins, 2006). What Airservices has done is identify and promote a type of behaviour, namely reporting, that facilitates the management of the most significant risks it faces.

Airservices is concerned to maintain a culture of reporting, that is, a culture in which reporting is the accepted practice, "the way we do things around here". Of course it seeks to educate its controllers about the importance of reporting, but does not *rely* on education. Rather, it closely monitors reporting practices and ensures that there are consequences when people fail to report. It is this very resource-intensive approach that has led to such high levels of reporting.

There is an interesting implication here. The survey of willingness to report revealed some dissatisfaction by controllers with the level of response they were receiving from head office. Another employee survey carried out by external consultants revealed quite low levels of employee satisfaction in some areas. The consultants concluded that "safety culture does not seem, to permeate top down". They justified this conclusion with the following words: "there is no clear evidence of consistent and obvious information flow and communications emphasizing safety"[12]. As already noted, Airservices is responding to these criticisms, and is now employing safety communicators. Moreover it is conducting an annual staff satisfaction survey. But the consultants' conclusions about safety culture cannot go unchallenged. HRO theory suggests that a safety culture is first and foremost a reporting culture[13]. From this point of view, the evidence is that Airservices has been very successful in creating a culture of safety, despite some level of employee dissatisfaction[14].

**Assessing the significance of incident reports**

When an incident is reported into a system, it must be assessed for its significance. How serious is the incident and what does it suggest about the need for change? In some industries there is considerable confusion about this process. It is worth describing some of this confusion, before examining how Airservices deals with the problem.

The process by which incidents are assessed for their safety significance is sometimes described as risk assessment. Take the following example recounted to me by the manager of an outback production facility. A company vehicle, travelling on a road near the facility, had hit a pothole and swerved to the other side of the road before the driver recovered control. The incident was reported to the manager, who in turn had the job of determining a risk score. The facility was in a remote location and the chances of hitting an oncoming car were very slight. But if there had been a collision, it might have resulted in a fatality, he said. If he took this into account the matter would receive a relatively high risk ranking and would need to be reported to corporate headquarters. How was he to assess the risk associated with the incident?

There is a fundamental problem with risk assessing incidents in this way. In order to identify the problem we must first outline the standard risk assessment process, which uses a risk matrix with likelihood and severity as its two dimensions. A scenario is hypothesised, such as a being injured while operating a particular machine, or flying into a hillside while trying to land at a particular aerodrome in poor visibility. The risk assessment then involves making a judgment about both the likelihood of the hypothesised event and its potential severity, and on this basis, assigning it is risk ranking. If the ranking is high, something must be done urgently to reduce the risk; if the risk is at the lower end of the scale, remedial action can be given a low priority.

The problem is that reported incidents are not hypothetical; they are actual. Furthermore, in the typical case, no harm has occurred. Strictly speaking it makes little sense to carry out a risk assessment for an incident that has already occurred and which itself caused no harm[15]. Nevertheless it is clear that certain incidents can sensibly be regarded as warning signs or indicators of danger and the challenge remains as to how to evaluate their significance[16].

## Airservices strategy for evaluating the significance of incidents

How, then, does Airservices deal with this problem? The primary function of air traffic control is to maintain separation between aircraft so as to prevent collisions. This very specific purpose has enabled Airservices to develop a distinctive way of evaluating the significance of incidents[17]. The evaluation involves two dimensions, the first concerning the degree of aircraft proximity involved in the reported event and the second whether or not the system defences functioned as intended. These two ideas will be explained in what follows.

The proximity dimension has three categories:

1. Aircraft came dangerously close to each other. The guidelines spell out in more detail what “dangerous” means.
2. Separation requirements were not maintained but the aircraft did not come “dangerously” close to each other.
3. Aircraft remain appropriately separated but some other potential hazard to safety existed (such as the entry of an unauthorized aircraft into controlled airspace or the failure of Airservices facilities).

Other things being equal, the first of these possibilities is regarded as the most serious and the last, the least.

The second dimension is based on the principle of defence in depth – the famous Swiss cheese model (Reason, 1997). (see diagram.) Safety in hazardous systems depends on multiple barriers or defences against hazards, so that if one defence fails, disaster may still be averted if other defences remain in place. Accidents only occur when all defences fail simultaneously (when all the holes in the cheese line up). In the present context the following defences stand in the way of accidental collision between two passenger aircraft. First, the aircraft should be following paths designed by air traffic control to keep them separated. Second, if they accidentally deviate from these paths in such a way as to reduce separation from each other, air traffic control, which is monitoring their progress, will advise of the error. Third, if air traffic controllers fail to notice or respond to such a deviation, pilots may become aware of the proximity of other aircraft by other means, such as radar, or even visually. Finally, if all else fails, the aircraft collision avoidance system will sound a warning to pilots when aircraft appear to be on a collision course (assuming the aircraft are equipped with such a system). If an accident is prevented by one of the early defences in the sequence, this is as less serious than if the last line of defence had to be activated. Most serious of all is when all defences fail and a collision was avoided simply by luck[18].

The two dimensions by which Airservices assesses the significance of incidents are arrayed in the table below.

| **Proximity** | **Defences** | |
|---|---|---|
| | One or more failed | Worked as expected |
| Dangerous | 1A | 1B |
| Breakdown of separation | 2A | 2B |
| No breakdown of separation | 3A | 3B |

This matrix serves to prioritise incident reports. Notice that the "defence in depth" dimension discussed above is collapsed into two categories: did one or more of the defences fail (A)[19],or did the defences work as expected (B). "A"s are more troubling than "B"s and "1"s, especially "1A", are enough make the hair stand on end, according to Airservices staff.

The number of cases in each category in the sample week identified above is given in the following table[20].

| **Proximity** | **Defences** | |
|---|---|---|
| | Failed | Worked |
| Dangerous | 0 | 0 |
| Breakdown of separation | 0 | 2 |
| No breakdown of separation | 10 | 92 |

The table shows that there were no cases where aircraft were in dangerous proximity and only two cases in which a breakdown of separation occurred. In these two cases the system defences operated as expected to restore separation. Of cases where there was no breakdown in separation, there were 10 in which system defences failed to perform as expected. It is clear from this description that the Airservices prioritisation system functions very effectively to direct attention to those matters requiring the most urgent attention.

It must be stressed that the prioritization discussed above reflects Airservices' concerns. An emergency landing necessitated by a mechanical failure, though a matter of great concern to passengers and aircraft operators, will nevertheless be classified as 3B, the lowest priority, as far as Airservices is concerned. The reason is clear. This is a system of priorities designed to assist Airservices to provide separation services as safely as possible; it is not designed to deal with all the hazards that confront an airline operator. Major airlines will have different systems of prioritization, as will the Australian Transport Safety Bureau, whose concern is to avoid accidents of all types. The priorities that Airservices has designed for itself are a thoughtful attempt to use its incident reporting system as efficiently as possible to learn from incidents in such a way as to maximize the safety of the separation service it provides.

This discussion highlights a distinction between collision avoidance, which is normally the responsibility of an air navigation service provider, and other aspects of flight safety for which the airline or perhaps the pilot has some responsibility. This distinction has been noted in other parts of the world. It has been argued in Europe that compartmentalizing safety in this way detracts from overall passenger safety and that in years to come the two will need to be united[21]. Be this as it may, it is clear that the reporting system used by Airservices is designed to maximize safety in matters for which it is responsible.

Things never stand still, however, and the system of prioritization described above has being supplemented by a second system. The perception at Airservices was that the system described above did not focus sufficiently on the defences for which Airservices was responsible. Accordingly it has developed a way of focussing even more tightly on matters that are within its control. The new system does not classify all incidents, only those that are attributable to Airservices. For this reason it supplements rather than replaces the earlier system. It consists of the following four categories[22], in increasing order of severity.

1 Errors or failures by air traffic controllers that are identified and rectified by the person responsible or by some other air traffic controller, before they have any significant impact on aircraft. (Rectified by ATC)

2 Errors or failures by air traffic control that are identified by air traffic control but can only be remedied by requiring significant corrective action on the part of an aircraft, such as a go around or a change of course. (Rectified by ATC, but not effectively)

3 Air traffic control errors that are not identified by air traffic controllers, and are identified by other parties such as pilots or other air navigation service providers. Airservices describes these as errors that “bleed out” or escape their system. (Rectified by pilot/ other industry participants)

4 Failures by ATC that are not identified by pilots or any other party and in which an accident is avoided only by the aircraft’s last line defence (its collision alert system), or simply by luck. (Providence/ airborne defence)

The supplementary classification represents a philosophical advance on the original one, in two respects. The original classification was influenced by whether the outcome resulted in a near collision. To some extent whether the failure of a defence results in a near collision or only a breakdown in separation is a matter of chance and there is no logical reason to give a higher priority to near collisions.

Second, the original classification reduces the defence failure dimension to two categories and does not specify whether the failure was attributable to ATC. The supplementary system focuses on errors by ATC and treats as most significant errors that are allowed to "bleed out" or escape from Airservices. Classifying errors in this way will enable Airservices to understand why it detects some errors more quickly than others and to learn from this how to recover from errors as quickly and with as little disturbance as possible. Recent thinking in accident prevention has emphasized that despite the best attempts to eliminate errors, people will nevertheless make them. What is important, therefore, is to design systems so that they are not disabled by errors or, to put it another way, systems that are as resilient as possible. It will be recalled that a commitment to resilience in the face of error, that is, a commitment to rapid recovery in the face of error, is one of the five characteristics of an HRO identified by Weick[23]. The supplementary system contributes to Airservices' performance in this respect.

It is evident, then, that Airservices has applied itself to the issue of classifying and prioritizing incident reports in a quite remarkable way. Few other organisations can match the analytic power that has been applied to the question of how to extract maximum value from an incident reporting system[24].

**The wider context**

Let us consider briefly the implications of this discussion for other contexts. The first and most important implication is that systems for reporting and prioritizing incidents must be tailor-made for the particular context. The two systems of prioritisation described above have served the needs of Airservices, but they will not necessarily be appropriate for other players in the aviation industry, let alone other industries. The failure of aircraft components, such as the blowout of a door, is a matter of great importance to the airlines themselves, but these failures are not prioritized in the Airservices classification systems. Organisations in other industries that seek to learn from the Airservices model will need to put considerable effort into identifying the things they want reported and devising their own priorities.

There is a particular aspect of the supplementary Airservices reporting system that limits its applicability in other contexts, namely its exclusive focus on error. There are certainly some contexts where this sharp focus may be useful. For instance, the errors made by surgeons during operations may have increasingly severe consequences the longer they go undetected and systems that encourage early detection and correction may well be appropriate in this context.[25] But in other contexts, incidents are not always the result of errors by front line operators. In particular, when flight safety is viewed from the point of view of the airlines, error is not the only source of incidents. Helmreich attributes incidents experienced by pilots to two sources, crew errors and threats. He defines a threat as “an event or error that is not caused by the crew, and increases operational complexity of a flight, requiring crew attention and management if safety margins are to be preserved” [26]. His research shows that for airlines the most prevalent threats are:

| Threats | Per cent of flights |
| --- | --- |
| Adverse weather | 61% |
| ATC[27] | 56% |
| Environmental operational pressures | 36% |
| Aircraft malfunctions | 33% |
| Airline operational pressures | 18% |

Based on this analysis, many airlines focus not just on error management, but on *threat* and error management[28].

In keeping with a concern about threats, some airlines operate a hazard reporting system quite independently of their incident reporting systems. Qantas, for instance operates a “safety observation report” system in which users are invited to report hazards or hazardous situations, such as poorly worded operational documents[29]. Poorly worded documents can contribute to misunderstandings and hence errors. Thus a hazard reporting system is, among other things, a line of defence against errors; it can facilitate error avoidance, not merely error recovery.

The Airservices reporting system is not designed to encourage the reporting of hazards of this nature. Its philosophy is that such hazards will be revealed in the analysis of errors to which they may give rise and that a good incident reporting system is sufficient to highlight hazards of this nature[30]. Of course not all hazards reveal themselves in this way and Airservices also maintains a quite distinct process for hazard identification that is independent of any reporting system. This will be discussed in a later paper.

**Using incident reports as an indicator of performance**

Airservices’ experience in using incident reports as an indicator of performance is worth outlining at this point. For several years it used the number of ATC-attributable incidents per 100,000 aircraft movements[31] as a safety indicator, and set itself the target of a 2.5 per cent annual reduction for each controller subgroup. However, in many cases targets were not met. Indeed the 2005-06 annual report notes that in the most recent five year period the number of incidents reported by tower controllers had increased by 300 percent while reporting by another subgroup of controllers had increased by 170 per cent. These results forced the organisation to reconsider its performance measurement strategy. It noted that

> “This surge in reporting is viewed by the organisation not as a decline in operating standards but as a reflection of an organisational culture which recognizes that submission of information about the smallest deviations can assist in identifying strategies to prevent high-risk occurrences. We therefore see the

> positive cultural driver as a major factor in two traffic segments failing to meet the target for the 2005-2006 financial year". [32]

Airservices had recognized its mistake. Generally speaking, an organisation that seeks to encourage reporting cannot at the same time treat the number of such reports as a performance indicator to be driven downwards. Cleary, Airservices needed to devise a more appropriate indicator. Accordingly, it chose to base a new set of performance indicators on the four part classification of controller errors identified above. The principal indicator was the number of incidents of the fourth type, that is, where the ATC error had been detected either by an aircraft warning system or it had not been picked up at all, and an accident had been avoided only by good luck. Airservices set itself the goal of zero incidents of this type, although it recognized that this would be difficult to achieve. It subsequently reported that it had four such incidents in the year in 2005/2006.

One of the features of this indicator is that type 4 incidents are likely to be reported by pilots into airline reporting systems as well as being reported by controllers into the Airservices reporting system. Any under-reporting by controllers will therefore be obvious as soon as the information is shared. Consequently, the number of such reports is likely to be a reflection of the actual number of such incidents, rather than simply a measure of the propensity to report. It is only if incident reports are relatively immune to variations in reporting practices in this way that they can serve as reasonably robust performance indicators.

A second feature of this new indicator is that is a measure of the number of ATC errors that have escaped the system entirely. Thus Airservices can improve its performance with respect to this indicator, not only by reducing the number of errors, but also by improving its capacity to detect and recover from errors before they escape. This will drive precisely the organisational behaviour that Airservices wants.

There has been much talk in other industries about the way certain safety indicators, such as lost time injuries, focus attention on relatively minor hazards, trip hazards, for example, while systematically diverting attention from catastrophic hazards such as fire and explosion. The oil and gas industry, in particular, is feeling its way towards indicators that more effectively measure how well the risk of explosion is being managed[33]. Airservices is an example of an organisation that has identified the risks about which it is most concerned and has now constructed a system of performance indicators to address these risks.

## Responding to reports

A reporting system facilitates organisational learning only if the organisation has developed ways of responding to reports. Too often reports end up in data bases and may be used for trend analysis, without any attempt being made to evaluate individual reports and learn from them. Airservices has a well developed system for responding to individual reports and extracting the greatest possible value from them.

Reports are made electronically and once submitted, are immediately visible, not only to the local line manager, but also to the central office in Canberra and to external organisations such as the Australian Transport Safety Bureau, the Civil Aviation Safety Authority and any airline concerned. There are protocols with these various external organisations to ensure whatever degree of confidentiality is appropriate, but this is a far more open reporting system than exists in many organisations where a key concern is often to protect the organisation from any legal liability for errors[34]. The wide distribution of Airservices incident reports ensures that as many pairs of eyes as possible are able to scrutinise the incident and maximizes the chance that appropriate lessons will be learned. The existence of multiple watchers, it will be recalled, is a recurrent theme in the theory of high reliability.

Once a formal incident report has been entered into the system, there are two sets of responses, one local and one corporate. I deal with these in turn.

*The local response*

Senior local area staff meet once a week in a safety panel that reviews incidents that have occurred during the week, as well as other safety related issues. These meetings can involve quite spirited discussion about whether the response to date has been adequate and they invariably give rise to further action items.

Apart from this, incident reports go to a line manager, who must decide whether a formal investigation is required. Where the manager decides that no investigation is required he or she must provide a written justification[35]. This a is vital safeguard, forcing line managers to respond in a conscientious fashion. In too many other reporting systems, managers have the easy way out of dismissing reports without providing any justification. This has led directly to disaster on more than one occasion[36]. Any decision not to proceed to an investigation is reviewed by a local area safety manager, providing further assurances of conscientious decision making.

If the matter is to be investigated, the line manager must appoint a trained investigator to carry out this task. The investigator compiles a written report. Until recently the investigator was also responsible for formulating recommendations. If the line manager accepted these recommendations they went into a corrective action data base[37] and were tracked till closed. This outcome was also monitored by the local area safety manager.

An interesting development in this process occurred when head office monitoring revealed that too many investigator recommendations were being rejected as impractical by line managers. In response to this discovery Airservices decided to change the process. In the modified system investigators make findings about causes but they do not make recommendations. The findings go to the safety manager. This individual meets with the line manager to develop agreed recommendations that are seen by the line manager to be practical to implement.

This focus on what is practical increases the likelihood that at least something will be done, but it has the disadvantage that more fundamental and more costly system enhancements may be discounted. Investigators examining why a controller has made an error often discover that the root cause is located in the computer software governing air traffic control displays. Changes to this software are time consuming and must be carefully risk assessed. The result is there is a long queue of system enhancements waiting to be carried out and three year delays are not uncommon. Faced with these constraints, safety managers may fall back on recommendations for more training, as the only practical way forward. This leads to a certain level of disillusionment among investigators. They know that the best response to hazards is to remove them; merely providing controllers with additional training in how to deal with hazards is second best. By no means all investigations lead to second best outcomes in this way. Moreover, it should be observed that it is the very quality of Airservices incident investigations that brings these issues to light. Nevertheless, this is one area in which, as Airservices acknowledges, there is room for improvement.

*The central response*

There is a second and quite distinct response to incident reports, at the corporate level, designed to ensure that the highest level of the organisation engages with what is happening at the front line. HROs, it will be recalled from the  earlier working paper, “are attentive to the front line, where the real work gets done”.

Each day a duty officer examines all electronic reports as they come in to the corporate headquarters, and selects the most significant incidents. The selection criteria used are roughly the criteria identified above. Very early the next morning the officer finalizes the list of significant incidents for inclusion in a “daily operations safety report”. He or she checks not only the main incident reporting system, but several other Airservices reporting systems, for anything that may be worth drawing to the attention of top management. The scanning process also extends to media reports. In this way the organisation casts the net as widely as possible The resultant list may contain a dozen or so items. The list is delivered to the corporate safety manager by 7.30 each morning. He studies it closely and then presents the report at 8.30am to an “executive morning briefing”. This meeting is usually attended by the Airservices CEO and most of the general managers who report directly to him. The executive group will highlight anything requiring follow up and this is duly attended to by the safety management group. The daily operations report also contains information on the status of matters previously highlighted for follow up in this way. Finally, the report contains a “safety issue list” designed to keep unresolved safety issues in the consciousness of executive group members. For instance, one of the issues discussed on the day I observed the process was an ongoing concern about the integration of civilian and military ATC at an aerodrome that services both civilian and military aircraft. There had been several incident reports highlighting problems at the interface of these two systems and the executive group wanted the matter resolved as quickly as possible. The CEO undertook to raise it with the Chief of the Air Force with whom he happened to be meeting that day. The incident illustrates quite nicely how the system that Airservices has designed for itself escalates issues to the very top of the organisation, thus maximizing the likelihood of decisive action.

These procedures involving senior management appear to duplicate the local investigative response to some extent. But they ensure that corporate officers in Canberra remain in daily contact with front line issues and they minimize the risk that critical matters will somehow be lost in the system.

**An example: the response to a report of overload**

The response to one particular report demonstrates this system in action. The report, as it happens an event rather than an incident report, concerned an occasion of significant job overload.

In order to set the scene it is first necessary to observe that two of the greatest threats to ATC safety are controller fatigue and controller overload. Both the controllers and their managers are well aware of these threats and manage them carefully.

Supervisors monitor work loads, but controllers don’t wait for supervisors to intervene. They know best if the number of aircraft in their sector is becoming difficult to manage and they can request that the sector be divided in two, represented on two different screens, and another controller brought in to share the load. Supervisors generally endorse these requests and the staffing arrangements at Melbourne control centre are generally such that there are additional controllers on hand.

Fatigue is the other great enemy. Controllers are encouraged to call in sick, if they are fatigued, for example, if they have had a bad night. There is basically no limit to the amount of paid leave that can be taken in this way, except that days cannot be taken consecutively. One controller told me that he had taken a total of 20 days off in one year because of bad nights caused a new baby. Furthermore, supervisors routinely check on controllers for signs of fatigue or other problems. Perhaps once a month a supervisor may decide that a controller is too tired to be working and needs to be replaced, always on full pay. Shift length is designed with fatigue in mind and varies from eight hours for various overlapping day time shifts down to six hours for the midnight to dawn shift. Even so there is considerable debate about whether the fatigue is being properly managed[38].Resource constraints have meant that there are not enough controllers to cover all shifts adequately, and controllers are frequently called in to work overtime. This has exacerbated the fatigue problem. There is a world-wide shortage of air traffic controllers and Airservices has not yet found a way to respond to this shortage.

Supervisors are also attuned to any medical issues that controllers may have. One controller who had just been diagnosed with cancer was taken off the job, on full pay, because of concern that his condition might distract him. In short, there is a very high level of scrutiny of fitness to work, higher even than exists for airline pilots.

Against this background let us consider, now, a report made by a controller following a midnight to dawn shift (the doggo shift). The report noted: “traffic levels and complexity on doggo approaching unsafe capacity” and went on to provide details. The sector concerned was traversed by international aircraft destined to arrive at capital cities in south eastern Australia at day break, and traffic congestion in the sector was greatest around 4am. The work was complex because aircraft were not following fixed routes but were being allowed to follow flexible tracks, to take advantage of tail winds. The sector was managed by three controllers, in accordance with minimum staff guidelines but at about 4am one of the controllers, who had been unwell, declared himself unfit for work and left for home. There was apparently no possibility of rostering additional staff at such short notice and this left two controllers to carry an exceptionally heavy work load, which they did without a break, until traffic began to ease some time after 5am.

A report of this incident was filed at 5.30am and was identified in head office in Canberra as a matter of concern, requiring followup. Accordingly, an investigation was carried out, resulting in a 24 page review document[39]. The investigation canvassed in some detail the way in which flex tracks had increased the workload and recommended that controllers should be able to modify flex tracks and fix aircraft in particular tracks where overload was becoming a problem, for whatever reason.

There are several things about this event report and the response to it that are worthy of note. First, the report concerns overload of front line workers. Fatigue and job overload are frequently identified as contributory factors in accident investigations in many industries and are clearly matters worthy of report. However there are few organisations where an experience of job overload would be deemed an appropriate matter to enter into an electronic reporting system. Second, the period of overload passed without mishap, yet controllers recognized that the situation was unsafe and therefore reportable. This demonstrated a high level of risk awareness. Third, the report did not just disappear into a data base. Head office identified it as a matter of high priority and resources were devoted to investigating it and exploring possible mitigation strategies. This account shows the Airservices reporting system operating at its best.

**Monitoring safety performance**

The databases which Airservices maintains provide it with the means to monitor safety trends of all sorts. In recent years it has been examining trends in breakdown of separation occurrences and closely studying the reasons for these occurrences. This research effort provides a glimpse of an organisation actively learning from its errors.

The research was initiated in 2003, following a serious breakdown of separation incident. Airservices safety staff examined data going back over three years to determine how and why the system’s defences were failing. Of 160 breakdowns that had occurred in this period, they found the great majority had been identified and rectified by controllers themselves. However, in 18 cases, the breakdown had been picked up by the pilot, while in two cases the last line of defence, an aircraft collision avoidance system, had been activated. In a sense, therefore, the system of defences was working reasonably well, although reliance on the last line of defence is never a satisfactory state of affairs.

The review then discovered that occurrences fell into two categories, which they called controlled and uncontrolled breakdowns. A controlled breakdown was one in which a controller was carefully monitoring an aircraft, perhaps inserting it in a landing sequence, and slightly misjudged the situation, so that two aircraft might end up 4.8 miles apart rather than the standard 5 miles. In these cases, the "rate of decay" of the situation was low and controllers rapidly recovered from such errors, perhaps by asking one aircraft to slow down. On the other hand, uncontrolled cases were those in which the controllers were caught unawares and "the rate of decay of the situation was high". The review team found that more than half the breakdown of separations were of this more serious, uncontrolled type and that controllers did not recover from these situations well. The report made a number of recommendations to deal with the problem.

Eighteen months later safety staff carried out a followup review. The followup showed that the initial review had had a dramatic impact on thinking within the organisation. Moreover there had been a sharp drop in the number of uncontrolled breakdowns of separation.

A further twelve months later, the figures showed two unexplained monthly "spikes" and another review of commissioned. It was concluded that the spikes were probably due to improved reporting of minor, that is, controlled breakdowns and that the proportion of uncontrolled breakdowns had continued to decline. However, examination of the circumstances of uncontrolled breakdowns suggested that a number of them had occurred because controllers had been distracted by non-routine events, such as aircraft radio failures and unusual weather events. Further followup action was taken.

This account shows how an incident reporting system, and associated incident investigations, can be used to great effect. It reveals an organisation energetically reviewing its errors, prioritizing them, studying their causes, learning how both to reduce their number and also to recover from them more efficiently, implementing this learning, and, finally, using its reporting system to evaluate how effective that learning has been. This is a learning organisation in action.

**Monitoring the effects of organisational change**

Incident reporting systems can also be used to evaluate the impact of organisational change. Airservices provides example of this that is worth describing.

Airservices carried out a major organisational restructure in 2006. Best practice dictates that major organisational changes, particularly those that involve staff reductions, should be subjected to management of change procedures, that is, they should be examined to determine the impact that they may have safety. It must be said that relatively few organisations measure up to this requirement[40]. Airservices, however, conducted safety assessment to ensure that the restructure was in no way detrimental to safety. This included a demonstration that all safety functions in the old structure were carried over into the new. But more than this, it included a series of hazard identification workshops with the new functional groups to pinpoint hazards associated with the new structure. The hazards identified by staff included: a dilution of felt accountability for safety, ineffective interface arrangements, documentation not amended and so on. These hazards were logged and controls established to deal with them[41]. In this way Airservices sought to minimize any potentially detrimental effects of the restructure on safety

Safety assessments such as the one described above can never provide a once and for all guarantee of safety. A risk-aware organisation that has carried out an organisational restructure will be concerned that uncontrolled hazards remain. It will therefore be alert to warnings of trouble. This is where Airservices has deployed its reporting system to good effect.

* It carried out trend analysis on incidents such as facility failures and loss of separation assurance to identify any possible impact of the changes on ATC performance.
* It improved the availability of its confidential reporting system so that staff could identify concerns that may have arisen about the new structure
* It monitored the level of reporting to ensure there was no negative impact on the established reporting culture
* It reviewed the rate of closure of investigation recommendations.

These monitoring activities revealed no changes in incident rates. However, two issues did emerge. First, reports were not being made as promptly as previously. This was raised with relevant managers and immediately resolved[42]. Second, resource limitations under the new structure were hampering the implementation of recommendations arising from incident investigations[43]. This was drawn to the attention of management.

In summary, intelligent use was made of the incident reporting system to pick up warnings about possible detrimental effects of the new organisational structure on safety. Here again we see a risk-aware organisation worrying about the possibility of failure and mobilizing its resources to deal with this possibility. What is especially significant about this example is that it concerns safety risks associated with organisational change, not something that most organisations deal with well.

## Conclusion

Airservices operates a highly developed reporting system designed to identify and respond to warnings of danger. It has decided what it wants reported and it has gone to great lengths to develop a reporting culture, that is, to ensure that people in fact report what they are supposed to. The organisation has put thought into prioritizing these reports and it has structured itself to bring the most significant events to the attention of its most senior managers, including its CEO, on a daily basis. Finally, it has a system for carefully investigating the most significant incidents in order to learn from them.

Airservices is an organisation that worries about the possibility of things going wrong. It exhibits the chronic unease that has been identified as one of the crucial characteristics of HROs. James Reason puts it well:

> "If eternal vigilance is the price of liberty, then chronic unease is the price of safety. Studies of high-reliability organisations … indicate that people who operate and manage them tend to assume that each day will be a bad day and act accordingly. But this is not an easy state to sustain, particularly when the thing about which one is uneasy has either not happened, or happened a long time ago, and perhaps to another organisation"[44] .

Importantly, chronic unease is not just a state of mind. It manifests as a set of practices aimed at detecting problems and rectifying them before they culminate in disasters[45]. Moreover, Airservices practices ensure that its most senior managers are kept abreast of whatever bad news there may be at the work face.

Finally it needs to be stressed that any organisation seeking develop its capacity to hunt out and correct errors must devote considerable resources to the task. It is not sufficient to issue an instruction to staff to report and then to assume that they will. The Airservices experience suggests that it takes a dedicated and active central safety management group to make this happen. Moreover, learning from these reports is not automatic. Again it requires an active corporate safety group to ensure that the organisation really does learn from its errors. There are currently about 90 people, in an organisation of 3000, who are specifically concerned with safety.They are at various geographical locations but they report to the central safety group, headed by a general manager who himself reports directly to the chief executive. This is precisely the kind of structure needed to drive the systems described in this paper.

This paper has provided a sketch of how one organisation has gone about designing and implementing a system to capture warnings and learn from them. It is a case study of what it means to be a learning organisation which, as was argued in the earlier paper, is a central feature of the HRO ideal.  Other organisations that aspire to the HRO ideal have much to learn from Airservices.  This does not mean that Airservices' practices can or should be slavishly followed.  Each organisation must work out for itself what the relevant warning signs are and what the most appropriate strategy is for capturing and learning from them. The Airservices case is useful, however, in identifying some of the issues to be addressed.

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[1] Hopkins, A (2000) *Lessons from Longford.* Sydney: CCH
[2] For a useful account see, Van der Schaaf T, Lucas D & Hale A (eds) (1991), *Near Miss Reporting as a Safety Tool*. Oxford: Butterworth
[3] *Transport Safety Investigation Regulations 2003*, Reg 2.3, 2.4
[4] Air Safety Occurrence and Event Reporting, Section5 of the Manual of Air Traffic Services (MATS), 7.5.4.3, -7
[5] MATS, 7.5.5

[6] MATS, 7.5.9. Airservices also maintains a special systems to report pilot navigation errors and aircraft deviations from authorized heights. It operates a system of General Aviation System Safety Enhancement Reports (GASSER) for minor matters occurring at general aviation airport. There is also is system for reporting Airservices equipment defects (ASID). Finally there is a reporting system that focus on the health and safety of Airservices employees.

[7] Occurrence review report, 13/11/2006 to 19/11/2006 inclusive

[8] These events may also be reported through ASID.

[9] Weick, K., K. Sutcliffe & Obstfeld (1999). Organising for high reliability: processes of collective mindfulness. *Research in Organisational Behaviour*, 21, p93

[10] Airservices Australia, (2006, October) *Safety Management Group, Willingness to Report: Review of Reporting Behaviours of Air Traffic Controllers*,p7

[11] For a fuller discussion see Hopkins, 2005,chapter 1

[12] Dyson, L & Searles B (2005), "Ensuring a Safety and High Reliability Culture" Feedback report to Airservices Australia, , p3. The report was based on 14 interviews.

[13] See also Reason J (1997) *Managing the Risks of Organisational Accidents*, ( Chap 9

[14] For another example of successful culture creation see Hopkins, 2005, p105.

[15] In the case above one could treat the incident as having identified a hazard – the pothole. One can then imagine a scenario, namely a car hitting the pothole and swerving into the path of an oncoming car. This imaginery event can be sensibly risk-assessed.

[16] Dijkstra (2006:189) states that current practice in the airline industry to assign a risk level to reported events using the IATA risk matrix. Dijkstra A 2006, pp183-204 in "Safety management in airlines", in E Hofnagel, d woods & N Leveson (eds) *Resilience Engineering*, Ashgate, Aldershot. As noted in the text, strictly speaking, this cannot be what is going on.

[17] ESIR Business Rules, pages 42,4 of 12/12/2005

[18] This second dimension is widely recognized in the aviation industry. Macrae coins an interesting term to describe what is at stake: "organisational risk resilience". Safety "requires resilience to the risks of minor operational failures escalating, by ensuring systems of defences remain in place beyond any actually called upon". In other words, an organisation is resilient with respect to risk if problems are detected early in the sequence of defences; if the problem is remedied only by the last line of defence, or if all defences fail and an accident is avoided purely by luck, resilience is said to be degraded. Macrae studied a large airline company and found that "operational incidents (were) used to diagnose where and how processes of organisational resilience are degraded, rather than to attempt predictions of future catastrophes". Putting this another way, the analysts he studied had moved away from the traditional concept of risk assessment in terms of likelihood and severity of consequences in order to evaluate the significance of an incident. For these analysts, the significance of an incident lay in what it revealed about the state of system defences. "Harnessing hindsight", www.lse.ac.uk/resources/RiskAndRegulationMagazine/magazine/summer2006
As Brooker notes, "the most important incidents to air traffic management system safety are surely those in which only the Alert layer (eg TCAS) prevents collision" Brooker P 2005, "Reducing mid-air collision risk in controlled airspace: lessons from hazardous incidents", Safety Science 43, pp715-738

[19] The A classification also includes cases where the control system was "significantly disrupted". This amounts to a failure of the defence system and has been collapsed here in order to simplify the presentation.

[20] The category "other'' is missing data and has been eliminated from the table

[21] Kirwan B & E Perrin 2004, "Imagining safety in European air traffic management", paper delivered to the 3rd International Conference on Occupational Risk Prevention, Santiago de Compostella. This matter is touched on in a previous chapter.

[22] AA Safety Management Group, *Review of Safety Severity Incidents 2* (December 2006), p14. The numbering above is the reverse of that used in this document.

[23] See also Hollnagel E, Woods D & Leveson N (eds) (2006), *Resilience Engineering: Concepts and Precepts*. Aldershot, Ashgate.

[24] A petroleum company that I have studied identifies "high potential incidents" (HPIs) as ones which could have resulted in at least one fatality, if one additional defence had failed. In then applies more rigorous incident investigation procedures to its HPIs.

[25] Rosenthal M & Sutcliffe K (eds) 2002, *Medical Error*, Josey-Bass, San Francisco

[26] Helmrich, B 2006, "Red alert", Flight Safety Australia September-October, p29

[27] Notice that things that are errors from an ATC point of view are threats from a pilot's point of view.
[28] See presentation by Bob Dodd to "Emerging Approaches in Safety Analysis", Canberra 25-26, 2005
[29] ibid
[30] It would of course be open to controllers to report poorly worded documents through the event reporting system.
[31] Or jurisdiction tracks
[32] Airservices Annual Report, 2005-2006, p26
[33] See The Report of the BP U.S. Refineries Independent Safety Review Panel (The Baker Report), January, 2007
[34] Ref to Hopkins, Dilemma article
[35] ESIR Business Rules, issue 5 p 13
[36] Reference to Moura / Gretley paper. Hopkins A 2000
[37] Reports are called System Action Improvement Reports (SAIR) and the data base is called SAIR2000
[38] While this study was underway Airservices conducted an fit for duty audit focusing mainly on controllers experiences of fatigue.
[39] Review of event report 2005 1452. Conducted by Stephen Almond.
[40] A notable example was the 25% operating budget cut that BP imposed on all its business units, without careful attention to the safety consequences. This cut was implicated in the Texas City refinery explosion of 2005. See Baker report, fn 31
[41] The hazard logging system will be dealt with in a later chapter.
[42] Interview, 30/4/07
[43] Operational Restructure, All Phases, Safety Assessment Report, 8 June,2006, p42.
[44] Reason, op cit, p37
.[45] Not everyone appears to recognize that chronic unease is a desirable state. Consultants employed by Airservices noted the sense of chronic unease felt by Airservices staff and then spoke about the need for strategies to dissipate this unease. Dyson, L & Searles B (2005), "Ensuring a Safety and High Reliability Culture" Feedback report to Airservices Australia p12, 18